TOWARDS NATIONAL DROUGHT POLICIES IN LATIN AMERICA AND THE CARIBBEAN REGION

WHITE PAPER

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ACRONYMS

ANA	National Water Agency (Brazil)
APCA	Water and Climate Agency of Pernambuco
ASD	Area Susceptible to Desertification
ASIS	Country (ASIS – País) – Agriculture Stress Index System
CAF	Development Bank of Latin America
CAPES	Coordination for Improvement of High Level Personnel, Brazil
CariCOF	Caribbean Climate Outlook Forum
CARICOM	Caribbean Community
CARPHA	Caribbean Public Health Agency
CAZALAC	Regional Water Center for Arid and Semi-Arid Zones in Latin America and the Caribbean
CDEMA	Caribbean Disaster Emergency Management Agency
CBD	Convention on Biological Diversity
CDPMN	Caribbean Drought and Precipitation Monitoring Network
CELAC	Community of Latin American and Caribbean States
CEMADEN	National Center for Monitoring and Early Warning of Natural Disasters
CENAD	National Center for Risk Management and Disasters
CEPREDENA	Central American Coordination Center for Natural Disaster Prevention
CGEE	Center for Strategic Studies and Management in Science, Technology and Innovation
CIASI	Intersecretariat Drought and Floods Commission. Mexico
CIMH	Caribbean Institute of Meteorology and Hydrology
CNPq	National Council on Science and Technology, Brazil
CONACYT	National Council on Science and Technology, Mexico and Argentina
CONAGUA	Water National Commission of Mexico
CONPDEC	National Council on Civil Defense and Protection
CONCYTEC	National Council on Science and Technology, Peru
COP	Conference of the Parties
CPTEC	Center for Prediction of Weather and Climate
CWW	Caribbean Water and Waste Water Association
DRAPA	Drought Resilient and Prepared Africa
ECDPGDM	Eastern Caribbean Development Partner Group on Disaster Management
ECLAC	Economic Commission for Latin American and the Caribbean
ENSO	El Niño Southern Oscillation
EWS	Early Warning System
FAO	Food and Agriculture Organization of the United Nations
FUNCEME	Foundation of Meteorology and Water Resources of Ceará
GCM	General Circulation Model
GDP	Gross Domestic Product
GIS	Geographical Information System
GWP	Global Water Partnership

HFA	Hyogo Framework of Action
HDI	Human Development Index
HMNDP	High-level Meeting on National Drought Policy
IADB	Interamerican Development Bank
IBRD	The World Bank
INEMA	Institute of Environment and Water Resources of Bahia
IDMP	Integrated Drought Management Programme
IICA	Inter-American Institute for Cooperation on Agriculture
IMTA	Mexican Institute of Water Technology
INMET	National Institute of Meteorology
IPCC	Intergovernmental Panel on Climate Change
ITCZ	Intertropical Convergence Zone
IWRM	Integrated Water Resources Management
LAC	Latin America and the Caribbean region
LDC	Less Developed Countries
LAFDM	Latin American and Caribbean Flood and Drought Monitor
MERCOSUL	Common Market of the South
MEW	Monitoring and Early Warning
NADM	North American Drought Monitor
NAP	National Action Program to Combat Desertification
NDMC	National Drought Mitigation Center (NDMC) of the University of Nebraska
NDMP	National Drought Management Policies
NDVI	Normalized Difference Vegetation Index
NOAA	National Oceanic and Atmospheric Administration
OAS	Organization of American States
OCHA	UN Office for the Coordination of Humanitarian Affairs
PAHO	Pan American Health Organization
PMPMS	Drought Prevention and Mitigation Programs of Mexico
PNPDEC	National Policy for Civil Defense and Protection
PRODHAM	Hydro-environmental program
PRONACOSE	National Program against Droughts, Mexico
SATCA	Platform to Provide Early Warning Services and Capacities in Central America
SCP	State of Public Calamity
SDI	Streamflow Drought Index
SDR	Secretariat of Water Resources
SE	State of Emergency
SEDEC	National Secretariat of Civil Defense and Protection
SINPDEC	National System for Civil Defense and Protection
SMN	National Meteorological Service, Mexico
SPI	Standardized Precipitation Index
SST	Sea Surface Temperature
UNCCD	United Nations Convention to Combat Desertification (UNCCD)
UNESCO	United Nations Educational, Scientific and Cultural Organization
UN-SPIDER SEWS	(Central America) – A program pf the United Nations Office for Outer Space Affairs (UNOOSA)
UNDP	United Nations Development Programme
UNISDR	United Nations Office for Disaster Risk Reduction
UNW-DPC	UN-Water Decade Programme on Capacity Development
WCDR	World Conference on Disaster Reduction
WFP	World Food Program
WMO	World Meteorological Organization

EXECUTIVE SUMMARY

The Latin American and Caribbean Region is highly susceptible to drought. Droughts occur all over LAC, and though they are common in all regions, the effects of drought are more severe in the drylands. In some countries, for example like Argentina and Mexico and several Caribbean nations, over 60 per cent of the territory is classified as drylands. Overall, in most countries at least 20 per cent of the territory is classified as drylands (UNESCO, 2010). Drylands are home to 30 per cent of the population in South America, 23 per cent in North America and 25 per cent in Central America and the Caribbean (Reynolds et al. 2007). The climate of LAC is highly influenced by ENSO (El Niño Southern Oscillation), particularly in South America, Central America and the Caribbean, and in Mexico. The changes in sea surface temperatures of the tropical Atlantic also play an important role in the climate variability of the tropics.

The serious impacts of droughts are evident in all the countries in the region, from Mexico, through Central America and the Caribbean, down to Argentina and Chile. Due to widespread poverty, the impacts of droughts are not only economic and environmental, but mostly social. Rain-fed agriculture practiced by small farmers and indigenous groups is threatened in times of inadequate rain. Water supply systems are overloaded, and the deficit of water available for human and animal consumption brings suffering to local populations. Since the beginning of the XXI century, droughts in the LAC region have caused innumerable crop losses, killed livestock, reduced dam water levels, caused proliferation of pests and diseases, threatened energy security, increased forest fires, caused severe water shortages, increased migration and generated food shortages in the affected areas. Droughts increase the burden of women in particular, since they are traditionally responsible for fetching water for the households. When men are forced off the parched land in search of work and livelihoods, women and children are often stranded in the drought-affected areas.

Because of climate change and unsustainable land and water use, droughts are predicted to become more frequent and more severe in the future (IPCC, 2014). LAC countries suffer from climate variability and droughts and need to prepare for more dramatic climate events in the future. Facing the drought by establishing proactive drought policies will not only reduce present vulnerability to drought, but will also contribute to climate change adaptation.

There is a lot of experience addressing drought in LAC. Even though some responses aimed to reduce future vulnerability – for example, by building water reservoirs – the measures were mostly reactive, triggered and planned when drought was already advancing, and included distributing water, food and funds to the affected population.

In 2013, a High Level Meeting on National Drought Policies (HMNDP) was organized in Geneva by the World Meteorological Organization (WMO), the United Nations Convention to Combat Desertification (UNCCD) and the Food and Agriculture Organization of the United Nations (FAO), attended by representatives of 84 countries and major international institutions (Sivakumar et al, 2014). The HMNDP recommended that countries adopt proactive drought policies, focusing on risk reduction while improving responses to ongoing droughts. Also during the meeting, a capacity building initiative was launched by the UN-Water Decade Programme on Capacity Development (UNW-DPC), the UNCCD, WMO and FAO. The UN Convention on Biodiversity (CBD) also joined the initiative after it began operation. For the countries of the LAC region, a capacity-building workshop was held in Fortaleza, Brazil, in December 2013 (Tsegai and Ardakanian, 2014). During the HMNDP, the Integrated Drought Management Initiative (IDMP) was established by WMO and the Global Water Partnership (GWP), which was created to support countries and regions willing to adopt proactive drought policies.

At least two LAC countries, Mexico and Brazil, are developing national drought policies along the lines recommended by the HMNDP. Mexico launched the National Program Against Droughts (Pronacose), coordinated by CONAGUA, and Brazil created a Drought Monitor, coordinated by National Water Agency (ANA), for the Northeast drought-prone region. Other initiatives are being developed by several countries in South America, Central America and the Caribbean.

A Regional Conference on Drought Management in LAC was organized in August 2017, in Santa Cruz de la Sierra, by UNCCD and the Government of Bolivia, with the support of FAO and WMO. Participants included LAC National Focal Points of the UNCCD, representatives of FAO, WMO, the World Bank, and stakeholders from the Government of Bolivia. Participants have developed this white paper, following the recommendations of the HMNDP, and approved a Declaration of Santa Cruz, calling all LAC countries to adopt proactive drought policies. These documents were presented at the Thirteenth Conference of the Parties of the UNCCD, held in Ordos, China in September 2017. There, a new policy advocacy on drought was recommended for all countries to "Pursue a proactive approach on integrated drought management in the process of developing national drought policies based on the three key pillars of national drought policy."

The three pillars of a national drought policy are: (a) monitoring and early warning; (b) vulnerability and impact assessment; (c) mitigation and response. Coordination is a key element, as drought policies are usually inter-institutional and inter-sectoral. In case of federal countries, a drought policy requires cooperation and complementarity between all levels of government. International, bilateral and South-South cooperation are also very important in developing national drought policies.

Monitoring and Early Warning

Drought monitoring shows the current state of a drought and its development over time. The level and the depth of monitoring may vary from place to place and with the degree of maturity of the monitoring system. The drought monitor must include the most reliable information in a way that can be easily read and perceived by those who have to make decisions about drought and drought responses. Mexico and Brazil publish their Drought Monitor bi-weekly and monthly, respectively – in the form of a map validated by local experts.

Where a climate forecast is concerned, it is possible in some situations, to anticipate the changes in the climate, based on the study of sea surface temperatures of the Pacific and the Atlantic, as well as their causes and effects. In several regions, it is possible to indicate if in the next season – the next three or four months – there will be above average, average or below average rainfall. This information is useful for early warning systems and should be made available for the entire LAC region. This map could be easily composed and updated, using the calendar of rainy and dry seasons. This information would be instrumental for all stakeholders to build awareness and adopt preliminary decisions in case of potential drought in the sub-regions.

The information provided by the drought monitor and the forecasting system can be used to compose a system of **drought early warning**. It is easy to visualize early warning approach for rapidly progressing natural phenomena, such as floods and hurricanes, and much more challenging for slow-onset, creeping events such as droughts that develop slowly and irregularly in space and time. Drought early warning information has to be delivered carefully, explaining to potential users the nature, quality and the probabilistic rationale of drought. Considering this caveat, drought early warning is an important component of a drought policy. There have been remarkable advances in the last two to three decades in drought forecasting and monitoring, as well as the quality of climatic information, vulnerability and impacts of droughts. A system of early warning that is well managed, based on reliable information that is transmitted carefully to decision makers and other users, is an important factor in reducing the risks of economic, social and ecological impacts of droughts.

Vulnerability and impact assessment

Vulnerability assessment represents the second pillar of a drought policy. The risk of drought impacts is proportional to the degree of the drought and the level of vulnerability of the population and the region. Poor populations are in general more vulnerable, as they have fewer means to insure themselves from any kind of hazard. The dependence of these groups on rain-fed agriculture for their livelihoods makes them even more prone to the devastating effects of drought, together with the shortages of drinking water for people and animals. While there are many studies on the impacts of drought, the subject of vulnerability is less developed in research, and there are no mechanisms to deliver the coordinated data to decision-makers.

Mitigation and response

This forms the third pillar, which has the objective of organizing, planning and implementing mitigation and response strategies, actions, involvement of appropriate institutions, technical capacity and financial resources, including bilateral, regional and international cooperation.

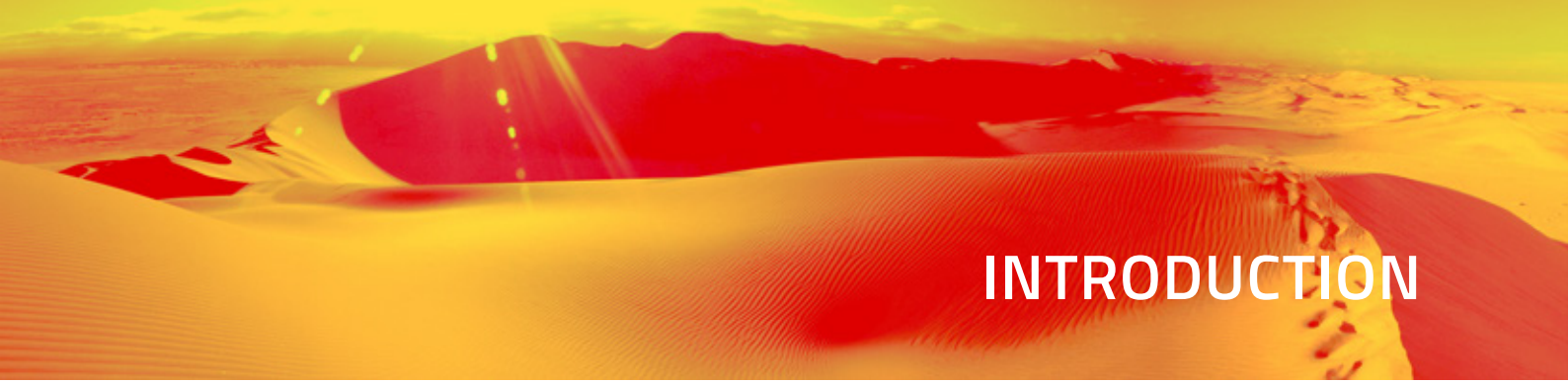
Mitigation involves all policies and programs that aim to reduce future vulnerability to drought, minimize the risk of drought impacts, or increase future resilience to droughts. Mitigation programs that reduce vulnerability to drought should be included into federal and state/provincial sustainable development plans, taking into account the link between drought, desertification and land degradation.

Drought **response** aims to alleviate the impacts of ongoing droughts. Once the event is underway, society and government react to protect those who are affected the most. Mitigation and response to drought should be included in the policy agenda at all times, including non-drought periods when there is more time to develop new ideas and design detailed response mechanisms. The focus should be mostly on drought preparedness programs such as who does what, the chain of command organized in advance and tailored to specific events as needed.

Some aspects of the drought policy run across the three pillars: institutional arrangements and coordination are fundamental. While coordination is inter-institutional, implementation may be done by sector, involving several layers of government. Capacity building and international, bilateral and South-South cooperation are also very important. The drought policy is more effective when it is inclusive and takes into account the most vulnerable segments of the populations, such as women, youth and indigenous peoples.

Finally, there must be political will to adopt and carry out the necessary steps of a national drought policy. Implementing a new policy requires the authorities at the highest level and the politicians to commit to the new initiative and provide the necessary leadership.

National drought policies should be adopted in all countries and regions, with the support of international organizations such as UNCCD, WMO and FAO. Regional organizations should support the drought preparedness initiatives of countries and sub-national governments and foster knowledge sharing of related tools and technologies.



INTRODUCTION

DROUGHT POLICIES, PLANNING AND MANAGEMENT IN LAC

The objective of this White Paper is to suggest the components of a proactive drought policy that could be adopted and implemented in the countries of Latin America and the Caribbean that experience frequent droughts, including Argentina, Chile and the Andean Countries, Brazil, Venezuela, Colombia, the Caribbean, the Dry Corridor of Central America and large parts of Mexico.

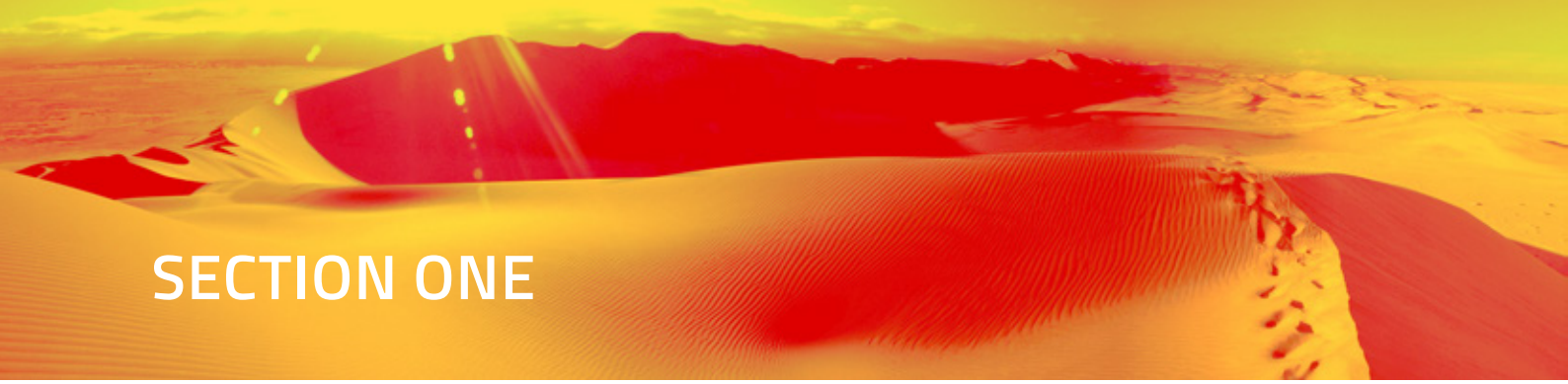
Drought affects all climatic regions beyond the drylands. The impacts may be economic, social and environmental. However, in poor dryland regions, social impacts are especially severe, since rural populations are often poorer than elsewhere especially vulnerable to drought, having limited options for alternative livelihoods beyond rain-fed agriculture.

A proactive drought policy and plan aims to reduce vulnerability and the costs of drought impacts to the country. This White Paper discusses the principles of a proactive drought policy, including its institutional dimension.

Concerned with the high costs caused by droughts, a High Level Meeting on National Drought Policies (HMNDP) was organized in Geneva, in March 2013 by the World Meteorological Organization (WMO), the United Nations Convention to Combat Desertification (UNCCD) and the Food and Agricultural Organization of the United Nations (FAO). Under the theme "Reducing Societal Vulnerability" Eighty-four countries participated in the HMNDP, approving a Declaration that called every country to adopt proactive risk-based drought preparedness strategy, instead of traditional reactive approaches.

In Section one, the pillars of a proactive drought policy are presented. Monitoring and Early Warning form the first pillar and should be established in all countries and regions. Second, Vulnerability and Impact Assessments should be developed to transfer the information to policy makers in an intuitive, user-friendly format. Third, Mitigation and Response strategies and actions require planning well ahead of a drought event, rather than after the disaster strikes, to reduce vulnerability and impacts. Mitigation strategies should also take into consideration the expected impacts of climate change, which may increase vulnerability.

There is much to be done in most countries of LAC in regard across the three dimensions of a proactive drought policy. Though the bulk of responsibility rests with the national institutions of each country, there is room for the regional, bilateral and international institutions to become involved. International support is particularly important for the monitoring and early warning stage in many countries. The institutional aspects are discussed in more detail in the following chapters, together with the need for international and regional cooperation and stakeholders' participation. Inclusiveness, especially the role of gender and indigenous groups, form another important dimension of a national drought policy.



SECTION ONE

THREE PILLARS OF THE NATIONAL DROUGHT POLICY

Based on the recommendations of the High Level Meeting on National Drought Policies (HMNDP) and on later developments, including the IDMP, the Capacity Building Workshops held by the UN-Water, the African Drought Conference in August 2016, the LAC Drought Policy Conference held at Santa Cruz de la Sierra in August 2017 and the recommendations of the Conference of the Parties of the UNCCD in the last three COPs (2013, 2015, 2017), a National Drought Policy in the LAC Region should be based on three pillars:

- **Pillar 1**: Drought Monitoring and Early Warning;
- **Pillar 2**: Vulnerability and Impact Assessments; and
- **Pillar 3**: Mitigation and Response

In addition to the three pillars, the Drought Policy must also define institutional arrangements, coordination, cooperation and participation of stakeholders, capacity building, and financing. Policies and programs of national and sub-national governments should be assessed from the mitigation and response perspective, including in the context of the civil defense system. A national drought policy could be a stand-alone policy or become a part of a general policy on disaster risk reduction and sustainable development.

While each pillar is coordinated by a different institution or set of institutions or a different branch of the same institution, there must be coordination within and among the pillars to ensure cohesiveness. This way, the information that is generated and/or managed in pillars 1 and 2, can be effectively used in pillar 3. The link between science and policy – how the scientific information is brought to the policy makers and made part of their decision making process – is key. This aspect needs considerable improvement. For example, there is a lot of research on drought and drought impacts in countries of LAC that does not reach decision makers in a form that is easily accessible and can be included into their decisions.

The three pillars that form the core of the Drought Policy are discussed below.

Pillar 1: Monitoring and early warning (MEW)

Drought is a slow-onset disaster different from other types of natural disasters such as floods and hurricanes. It is impossible to predict when the drought starts or ends – usually, the drought is already developing when it is recognized as such. In some places of LAC, due to tradition, the beginning of drought is often aligned with a religious holiday or another significant date, but by then it is usually too late for preventive measures, such as adjusting the planting times. For instance, in the north-east of Brazil the belief is that if it does not rain until March 19, a day of religious significance for the local population, then it is a drought year. In that region, the two rainiest months are March and April, when the Inter-tropical Convergence Zone (ITCZ) moves to the southern hemisphere and reaches the North of the Northeast. If it has not rained until the end of March, then, even if it starts raining, there would not be enough time for cultivating crops, signifying an agricultural drought.

Pillar 1 uses drought forecasting and monitoring to generate and transmit the scientific information on the climatic variables that influence drought conditions in a country or region. Alerting the population and decision-makers on the possibility of a drought are the most important uses of the information gathered through drought forecasting and monitoring, instrumental to the success of the early warning efforts.

Drought monitoring

Drought monitoring shows the current state of a drought and how it develops over time. The level and the depth of monitoring may vary from place to place and with the degree of maturity of the monitoring system. One key experience is the Drought Monitor of the United States, developed by the NDMC – National Drought Mitigation Center of the University of Nebraska, with the participation of several institutions of that country, such as NOAA and the US Department of Agriculture. The US Monitor provides weekly updates on the drought

situation, in the form of a map produced by the center and validated by a network of local experts.

Based on the U.S. Drought Monitor, the North American Drought Monitor (NADM) was launched in 2002 to monitor droughts in Canada, the United States and Mexico through cooperation between drought experts in these countries (NOAA n.d.), including NOAA's National Centers for Environmental Information, NOAA's Climate Prediction Center, the US Department of Agriculture, the National Drought Mitigation Center from the US, as well as the Agriculture and Agrifood Canada, the Meteorological Service of Canada, and the National Meteorological Service of Mexico (SMN – Servicio Meteorologico Nacional).

The Mexican Drought Monitor, which is part of the North American Drought Monitor, is updated twice a month by the National Water Commission (CONAGUA). The data is produced for watersheds, states and municipalities, and the degree of drought intensity is based on the U.S. Drought Monitor. Standardized Precipitation Indices (SPI) and Streamflow Drought Indices (SDI) are determined on a weekly basis for main weather points and stations (Arreguín-Cortés et al. 2015). Information on the Mexican Drought Monitor can be found on the site of the National Meteorological Service of Mexico (http://smn.cna.gob.mx/es/climatologia/monitor-de-sequia/monitor-de-sequia-en-mexico).

The Ministry of Environment of Argentina has been developing an early warning system for drought for the southwest region of Buenos Aires (Ministerio del Ambiente, 2017), as part of the project ¨Aumentando la Resiliencia Climática y Mejorando el Manejo Sostenible de la Tierra en el Sudoeste de la Provincia de Buenos Aires¨ (Increasing Resilience to Drought and Improving Land Sustainable Management in Southwest Buenos Aires). The project brings together Ministerio del Ambiente y Desarrollo Sustentable, Adaptation Fund, World Bank, Meteorological Service of Argentina and several technical and scientific institutions. The project started in 2015 with consultations of stakeholders and organizations involved. The following year, the project incorporated a forecast on climate variability for each three-month period and the dissemination of this information to stakeholders. In 2017 and 2018 the focus is on the improvement of data collection and the project's infrastructure.[1]

The Drought Monitor in Northeast Brazil is run once a month by meteorological institutions of the Northeast states, including Foundation of Meteorology and Water Resources of Ceará (Funceme), Water and Climate Agency of Pernambuco (APAC) and Institute of Environment of Bahia (INEMA. The Monitor produces information on relevant weather and other meteorological data on a monthly basis. Coordinated nationally by the National Water Agency (ANA), the Northeast Brazilian Drought Monitor is also validated by local experts to ensure the accuracy of the map.

The Monitor – its content, design and target audience

The drought monitor must include the most reliable information in a way that can be easily understood by those who have to make decisions on how to prepare and respond to drought. Two main types of audience targeted by a monitor are policy makers at various levels of government (including municipalities, states or provinces and the federal government) and the people directly affected by drought (such as the farmers and other water users). Informing the first group facilitates the process for declaration of a drought emergency; while the people who are affected by the drought can decide whether to adjust or temporarily discontinue their practices. The general public is informed by the media, which is the main distributor of the Drought Monitor. The resulting level of awareness on the drought situation is quite high, since various institutions at the level of state, province or federation are routinely required to monitor drought-related news and data.

According to the methodology initially created by the National Drought Mitigation Center (NDMC) for the US Monitor, and later adapted by different countries, basic information comes from known drought indices that have been developed by scholars and/or practitioners. The Northeast Brazilian Monitor, for instance, uses the following indices:

a. Standardized Precipitation Index (SPI);
b. Standardized Precipitation and Evaporation Index (SPEI); and
c. Standardized Runoff and Dry Spell Indicators.

A good presentation and description of several drought indices – including the ones used by drought monitors – can be found in the Handbook on Drought Indicators and Indices of the IDMP – Integrated Drought Management Programme, published in 2016. The indices are specifically calculated by the authors of Drought Monitors reflecting specific region realities.

In addition, the Monitor also uses other support products as well as information (a layer in the map) with the conditions of the reservoirs. According to Martins et al (2016), "the Monitor´s process combines various data sources, products, and information from all of the meteorological, hydrological, and agriculture/livestock monitoring systems of the federal and participating state governments, supported by local information."

The climate information used to build the indices comes from monitoring stations. The density of the network of meteorological stations defines the representativeness of an index. One possible solution to the low density of the data network is remote sensing and modeling to complement the stations' information. Countries with insufficient networks of meteorological stations, for instance, Central America where the stations are clustered on the Pacific side, might need additional investments into building the base for reliable climatological indices.

[1] The project was presented by the Ministry of Environmental and Sustainable Development of Agriculture in the Bolivia Drought Conference, 14-16 August, Santa Cruz de la Sierra, Bolivia.

Table 1: Classification of droughts according to the US, Mexico and Northeast Brazil drought monitors

Classification	Meaning
No classification (white)	No relative drought
D0	Abnormally dry
D1	Moderate drought
D2	Severe drought
D3	Extreme drought
D4	Exceptional drought

Source: De Nys et al, 2016.

The authors of the monitor combine several indices and other information to build a map, which illustrates the drought situation according to the classification presented in Table 1 and visualized by using a different color for each class on the map.

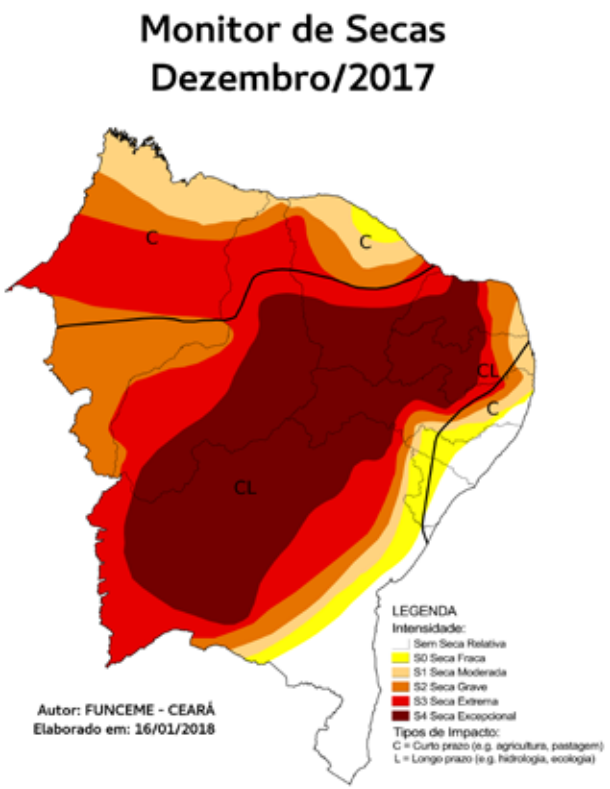
This classification was originally developed by the organizers of the US Drought Monitor and later used by the North American (including Mexico) and the Brazilian Monitor.

The process of validation is an important step in the preparation of the map. The map that is prepared by the climate institutions, based on the construction of indices and their integration into a Geographical Information System (GIS), may lack useful local data on vulnerability and impacts. In fact, the same meteorological drought may have different consequences locally, depending on specific conditions. For instance, in Bolivia municipalities that are highly exposed to droughts are not usually the most vulnerable, because of their physical and socioeconomic characteristics and their adaptation capacity, in comparison to other municipalities that are similarly exposed but are less prepared (UDAPE, 2016).

That is why it is essential to have each map assessed by local specialists, who can confirm whether there are some local characteristics that can affect the drought situation and its impacts. Validators need to be certain that their input reflects the current situation – for example, that a dam in the area is, in fact, fully stocked in case of emergency. There is still the need to allow for the possibility that the map will need to be adjusted later on, especially along the borders and within the transition zones.

Once the map is prepared and validated, together with a narrative description of the situation in each state, it is published and disseminated to all stakeholders. The use of the information supplied by the Monitor may be mandated legally – for instance, for the confirmation of an emergency situation – or may be voluntary to policy makers and other users such as farmers. The advantage of the Monitor is that its information is easy to understand, reliable and objective. This helps avoid political influence and vested interests in the declaration of emergency and consequently the eligibility to receive government funds.

Map 1: Northeast Brazilian Drought Monitor (December 2017)



Source: monitordesecas.ana.gov.br

Map 1 is an example of a map produced by the Northeast Brazilian Monitor. The sequence of maps and narratives can be found on the site of the Brazilian Water Agency (ANA – Agência Nacional de Água), at <monitordesecas.ana.gov.br>.

The author of the December 2017 Drought Monitor is Institute of Environment and Water Resources of the State of Bahia (INEMA). The map represents the following drought situation in colors from lighter to darker colors: without relative drought, S0 light drought, S1 moderate drought, S2 severe drought, S3 extreme drought, S4 exceptional drought. It also presents types of impact: C – means short run (for examples agriculture or fodder), L means long run (for example, hydrology or ecology).

There are other examples of drought monitoring in the LAC region. In 2009, the Caribbean Drought and Precipitation Monitoring Network (CDPMN) was launched under the Caribbean Water Initiative (McGill n.d), led by the Brace Centre for Water Resources Management at the McGill University and the Caribbean Institute for Meteorology and Hydrology (CIMH). The CDPMN centralizes a number of indices to monitor droughts in the Caribbean at regional and national scales. A participatory process, involving local experts, determines the final drought and precipitation status of the region/country (FAO 2016).

In collaboration with Central American Coordination Center for Natural Disaster Prevention (CEPREDENAC) and several other global and local partners, the World Food Program (WFP) developed SATCA, a platform to provide early warning services and enhance capacity in Central America. SATCA provides precise, timely and real-time information on natural hazards, including droughts to improve disaster preparedness, mitigation and response (WFP 2009).

In 2014, the Terrestrial Hydrology Research Group at Princeton University developed the Latin America and Caribbean Flood and Drought Monitor (LAFDM). The monitor provides current meteorological information (precipitation, temperature, radiation and wind speed), as well as drought indicators (SPI, soil moisture, NDVI) and flood indicators (surface runoff and stream flow). The portal shows both historical data, monitoring of current conditions and forecasts for LAC (UNESCO 2016).

Another tool called "ASIS – Country" (ASIS – País) was developed by FAO to strengthen agricultural drought monitoring and early warning systems in developing countries. This tool is based on the methodology of FAO's Agriculture Stress Index System (ASIS) that works at the global level to support the Global Information and Early Warning System (GIEWS). "ASIS – Country" is calibrated with information on land use, planting dates, crop cycle duration and crop coefficients. FAO provides satellite information every 10 days and the final results are easy-to-interpret maps for decision-makers to implement mitigation actions. Results have already been presented for drought affected agricultural areas in Nicaragua (FAO 2017).

Launching a region-wide monitor for the whole of Latin America and the Caribbean (or combining several country or sub-regional monitors) together with a periodic map on the regional drought situation would create a useful tool for national and regional decision-makers, as well as international organizations.

Climate forecasting

By using the drought monitor, one can follow the development of a drought through various stages. In some situations, it is possible to anticipate the climate conditions, based on the study of tele-connections, in particular the sea surface temperatures, their causes and effects. This information is useful for early warning systems. There are ongoing experiences of climate forecasting in Mexico, Central America, the Caribbean, and some countries in South America.

It is difficult to forecast the climate, with varying degree of difficulty from region to region. Dry and wet years in LAC are in general influenced by the sea surface temperatures (SST) of the Pacific Ocean, especially the El Niño Southern Oscillation (ENSO), and the Atlantic Ocean, such as the Atlantic Dipole (alternation of warm and cold temperatures between the North and the South Atlantic). These two global phenomena usually happen sometime before a dry year (drought) or a wet year is defined, so that it may be possible to foresee how a defined season will unfold based on the temperature of the oceans or their trends. There is already reasonably good information on the SSTs of the Pacific, because of the global interest in ENSO, but there is less information available on the SSTs of the tropical Atlantic. The information on the SSTs in the Atlantic needs to be improved, along with the degree of predictability of the SST in both oceans.

Additionally, there are other regional factors that influence the climate, such as cold fronts and eastern winds. For instance, the ENSO phenomenon serves as an important determinant of the climate in Central America, in the Caribbean and in Mexico. There is a well-established correlation between El Niño – the warming of the Pacific on the coast of Peru and Ecuador – and drought in Northeast Brazil (though there have been several El Niño years without drought), Central America and Mexico. The connection is much less obvious in to Central South America, and to floods in Southern Brazil, Uruguay and Northern Argentina, and the correlation is far less predictable in Central South America. In general, the influences of cold fronts and winds cannot be predicted more than a few days in advance, and the forecast will always remain tentative.

The SST information is not always straightforward. There is a need for expert knowledge to transform the climatic information into climate forecasting to produce a consensus on climate models offered by the scientific community. In the case of Northeast Brazil,

where a reasonable forecasting can be exercised for a few months, the data on the Pacific and Atlantic SST, together with other important climate information, are assessed by a group of scientists from various climate organizations to produce a climate forecast.

The group of scientists meets every year, in December/January, to assess the climatic data and to agree on a forecasting for the next four months. Such forecasts usually state that there is a chance of "x" per cent of rain above average, below average for the next season. So, the forecast is based on probability and cannot state with complete certainty the onset, development and end of a drought, though there is an increasing pressure from policy makers for more definite forecasts. The group issues a map showing the areas where rains will likely be above, around or below average.

There are also forecasts based on numeric models that avoid the subjective component required in consensus models. Examples of consensus and numeric forecasts are shown in Box 1, on the two types of forecasts that are done for Brazil and South America.

Even though a significant progress has been made in the past two to three decades, there is still significant room for improvement in climate forecasting in LAC and in each of its sub-regions. This is an area to be strengthened by global and international organizations, such as WMO, NOAA and IRI, by national organizations, especially of the big countries of LAC, and sub-regional organizations for Central America and the Caribbean.

A map for the whole LAC could easily be produced and updated in accordance with the calendar of the rainy and non-rainy seasons. What makes climate forecasting essential to early warning systems is that

BOX 1.

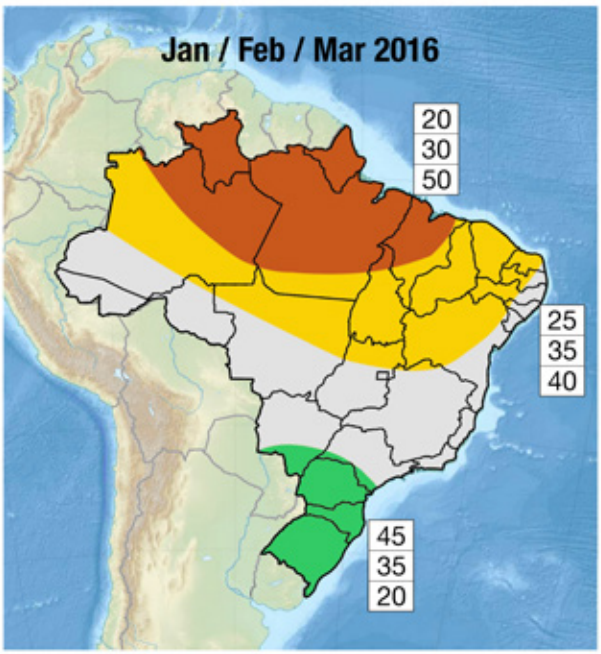
FORECAST IN BRAZIL

Brazil has two climate forecasting systems in place. One is a consensus model, which provides a seasonal climatic forecast and is coordinated by the Center for Prediction of Weather and Climate (CPTEC), with the participation of National Institute of Meteorology (INMET), and some state meteorological centers. The second system is based on numeric models and offers a forecast that does not depend on the opinion of experts, but rather it comes straight from the outcomes of the numeric models.

Both systems define the probability of rain for the next three months in three categories (or ranges) of precipitation: below average, around average and above average. In the first system, the definition of probability in the three categories is based on the opinion of a group of experts from different institutions. To support their opinion, the experts discuss the monitoring of atmospheric and oceanic fields (dynamic models) and past data (statistical models). The output (Map 2) is a map that is published by CPTEC and shows the climatic forecast for Brazil and South America.

In the second system, that also results in a map (Map 3a,b) with probabilities of precipitation in the three categories, per region or sub-area, there is no interference of the experts in the models´ results. This map is published by the Foundation of Meteorology and Water Resources of the Ceará state (Funceme).

Map 2: Probabilistic forecast (in thirds) by consensus of the total rainfall during January-March 2016.

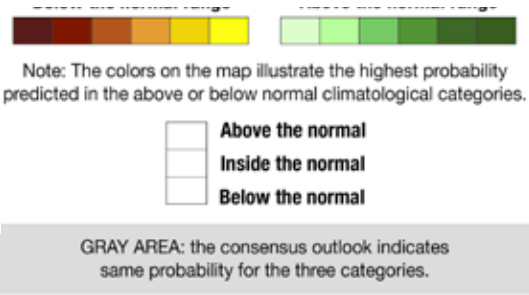


Forecasting probability (%) of seasonal precipitation in three categories.

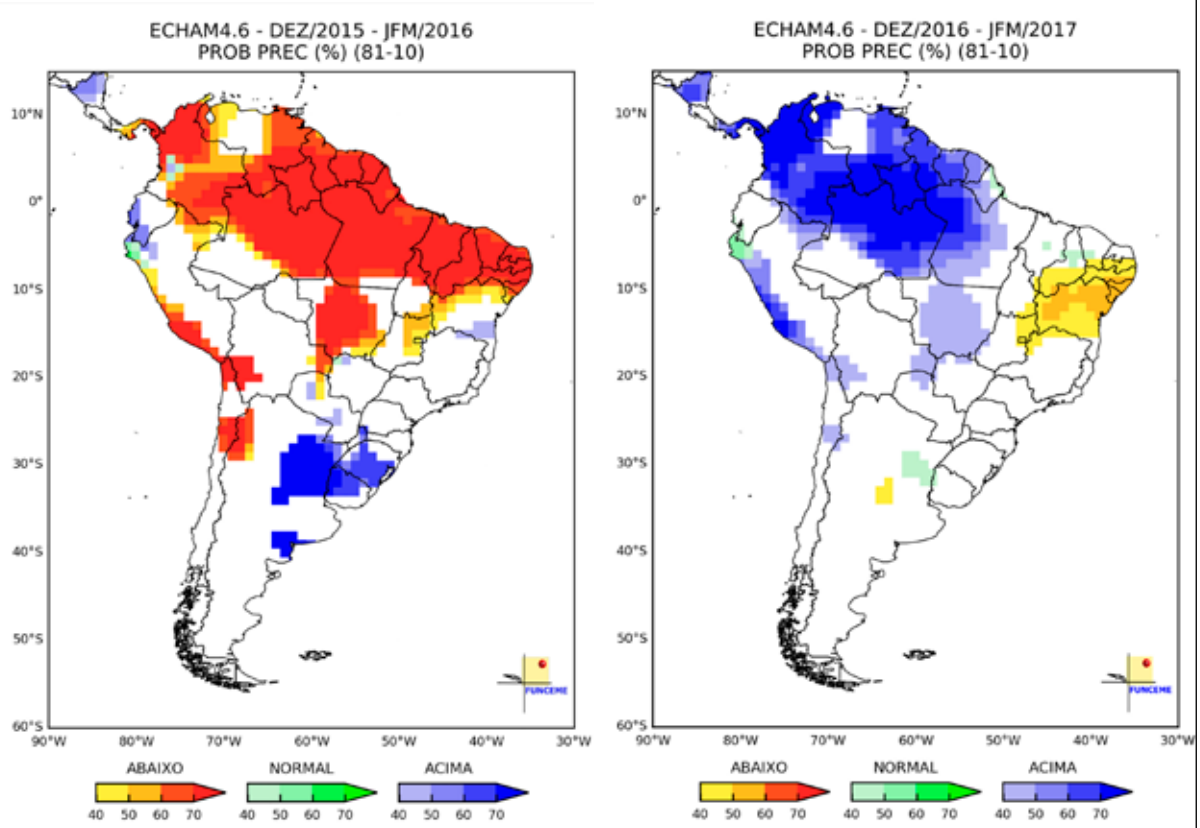
Source: CPTEC

The map shows the climatic forecast for Brazil with the probability of rains below, around average and above average, for January, February and March 2016. The forecast was prepared in December 2015. ¨Abaixo¨ (low) indicates less rain; ¨Normal¨ (average, normal) indicates rains around average; and ¨Acima¨ (above) indicates rains above average rainfall.

The other system used in Brazil is based on numeric models and offers a forecast that does not depend on the opinion of experts, but results from the outcomes of the numeric models. The forecasts presented by Funceme in December 2015 and 2016, for January, February and March of 2016 and 2017, are shown in Figures 3a and 3b.



Map 3: Forecasts for the three categories of precipitation presented by Funceme, in December 2015 and 2016, for January, February and March of the following year



The color legend shows the probabilities in relation to each category.

Source: Funceme

it produces convincing information that governments and other decision makers can use to create drought awareness and adopt preliminary response measures specifically for their sub-regions.

Early warning systems (EWS)

The information provided by the drought monitor and the forecasting system can be combined to produce a system of drought early warning. The concept of early warning is easily applied to such rapidly developing phenomena as floods and hurricanes. When a possibility of heavy rainfall is forecasted, the early warning system will communicate that information to decision makers and the population of the affected region, especially if the region is vulnerable to floods. These often include low-lying city districts or valleys in rural and mountainous areas that have been deforested or contain unstable structures.

As a creeping and slow-onset phenomenon that develops slowly and irregularly in space and time, drought presents a more challenging subject for early warning systems. This year's drought is never the same as the ones that happened before. For instance, there may be a meteorological drought, but when rains are well distributed in time and space; it may not result in agricultural drought, meaning lesser impact on agriculture, rural employment and income.

One condition for a successful early warning is to have adequate information that comes from the drought monitor, climate forecasting system and other sources, such as statistical studies. However, the information will always be probabilistic, since it is not possible to predict a drought with 100 per cent accuracy. For instance, early warning uses climate forecasts and statistical data, and this information is probabilistic. The early warning system can also inform about the possible outcomes of a drought, in terms of how the drought would affect the region and the population. Early warning also benefits from the information provided by Pillar 2 (explained below), on impacts of, and vulnerability to droughts.

After the information becomes available, it is essential to identify the potential users for the early warning system. The target audience includes policy makers of the government, water users in the agricultural areas, water supply agencies and farmers.

The issue of transmitting the information – the science-policy link – also plays a very important role, since policy makers, for instance, do not necessary always know how to deal with the scientific probabilistic information. They want to know whether there will be a drought next year, not that there is a probability of a certain amount of precipitation.

This approach has its reasons: to acknowledge a probability of drought means that relevant decisions need to be made and a course of action defined, and this will bear a significant cost to all involved. If the farmers are advised not to plant due to the possibility of drought, this will mean wasted effort in preparing land for planting, unemployment, lack of agricultural production and absence of bank financing. On the other hand, if the threat of drought does not materialize and there is sufficient rain, those few who decide to plant despite the drought warning, will benefit significantly from higher prices due to the scarcity of agricultural products on the market.

Therefore, an extreme caution needs to be taken when delivering drought early warning information, explaining to potential users the nature, quality, and the probabilistic rationale of drought forecasts.

Considering this caveat, drought early warning is an important component of a drought policy. There have been remarkable advances during the last two to three decades in drought forecasting and monitoring, as well as in the quality of climatic information, vulnerability assessments and projections of drought impacts. A system of early warning that is well managed, based on reliable information and transmitted carefully to decision makers and other users, may be an important factor in reducing the economic and social impacts of droughts.

In summary, a drought early warning system (a) collects and integrates key data, such as drought indices, (b) transforms the data into information products to be transferred to potential users at the local, regional, state or provincial, national levels, and (c) transmits the information to users. A useful guidance for the implementation of early warning systems is provided in the publication ¨Developing Early Warning Systems: A Checklist¨, outcome of the Third International Conference on Early Warning¨ that took place in Bonn in 2006 (ISDR, 2006). The publication presents a checklist of basic elements, actions and good practices associated with effective early warning systems.

Pillar 2: Vulnerability and impact assessments

Drought risk is determined by the severity and frequency of a drought and by vulnerability of the population or the environment in a drought-affected region. Risk of drought is the indication of the probability that a drought will occur and its likely severity. Vulnerability of a population or an environment is the indication of how much the social or environmental situation will be affected by a drought.

BOX 2.

DROUGHT AND EARLY WARNING IN THE CARIBBEAN

Immediate Drought Concerns for CDEMA Participating States – Information Note #1 as of February 12, 2016.

Several Participating States in the Caribbean Disaster Emergency Management Agency (CDEMA) system have been placed under immediate drought watch or warning for 2016. The drought situation remains a major concern for many countries due to the below-normal rainfall recorded during the previous dry and wet seasons, which resulted in a number of countries experiencing water shortages in 2015. Drought alerts have been issued by the Caribbean Institute of Meteorology and Hydrology (CIMH) for several countries up to March 2016. Drought warning has been issued for Antigua and Barbuda, Barbados, Dominica, northern Guyana, St. Kitts and Nevis, Saint Lucia, St Vincent and the Grenadines, Trinidad and Tobago and northern Suriname. A drought watch has also been issued for Grenada.

Drought outlook for the short-term (till March 2016) may result in a rise or persistent drought situation in Haiti east-and southward and especially in Antigua, Barbados and the Leeward Islands. The longer-term outlook (beyond March 2016) will see a drier early part of the year in the Lesser Antilles due to a peak in the strength of El Niño. A drought watch is therefore issued for the Bahamas and southwest Belize.

The national water management authorities continue to lead at the national level and the Caribbean Water and Wastewater Association (CWWA) is on alert and planning for future actions.

CDEMA called a meeting of the Eastern Caribbean Development Partner Group on Disaster Management (ECDPGDM) in early February 2016. Other key stakeholders including Caribbean Water and Waste Water Association (CWW), Caribbean Public Health Agency (CARPHA) and the Pan American Health Organization (PAHO) have been alerted. CDEMA will continue to coordinate with the Participating States on readiness for drought conditions and provide updates as necessary.

The Caribbean Climate Outlook Forum (CariCOF) of the Caribbean Institute for Meteorology and Hydrology (CIMH) has prepared a drought outlook for the Caribbean (by the end of March 2016).

Source: Caribbean Climate Outlook Forum (CariCOF), Caribbean Institute for Meteorology and Hydrology (CIMH), Immediate Drought Concerns for CDEMA Participating States – Information Note #1 as of February 12, 2016.

Drought as a hazard

There are several definitions of drought (Wilhite and Glantz, 1985): meteorological, agricultural, hydrological, and socio-economic. A meteorological drought is represented by a fall in precipitation in relation to the average annual precipitation. An agricultural drought is related to the degree of soil moisture and its capacity to grow crops. A hydrological drought is determined by the water balance, amount of runoff, and the state of the reservoirs. Finally, a socio-economic drought is identified by its socio-economic impacts.

Another way of defining drought would be to consider the decrease in precipitation (less rain) as the underlying cause of the drought, while soil moisture, runoff and socio-economic issues could be considered as first or second-order impacts. Whichever definition is used, a drought represents a situation when reduced rainfall and diminished water supply affects all sectors and human activities that depend on water supply.

Vulnerability

Vulnerability is linked to the sensitivity of a region, a society or an activity to drought. While all climatic regimes are subject to droughts, the semi-arid areas belong to marginal climatic regions that are more vulnerable (Parry et al, 1988). A small downward variability in the average annual precipitation can produce a significant impact that is further magnified if the area is densely populated. For instance, the same size of variability in Northeast Brazil (a semi-arid region) and in the Amazon rainforest (a humid region) can have different impacts. While the Amazon still remains humid even during diminished rainfall, in the Northeast, any small reductions in rainfall will significantly impact the population and its activities.

In the semi-arid regions of developing countries the majority of land users are smallholder farmers practicing rain-fed agriculture, which makes them more vulnerable to droughts. The poor population of the drylands does not have any backup resources to rely on if the normal economic activities are interrupted by drought – any crisis creates a major impact on the lives of rural populations. However, for every drought event, it is necessary to identify all affected groups on a case-by-case basis, since even social groups that are normally protected from the risk of drought may be affected during severe back-to-back droughts.

For example, large scale farmers who practice irrigation are normally less affected by drought than subsistence farmers because they do not depend on rainfall. However, severe droughts, such as the ones in 2012 and 2016 had an impact on the level of rivers and reservoirs throughout the region, affecting irrigated agriculture as well. In Brazil, the National Water Agency (ANA) and some state water agencies have significantly reduced water allocation of irrigators in 2016 and 2017, halting irrigated agriculture production in some places. However, for wealthier farmers the impact was mainly economic, caused by the loss of revenues. For poorer smallholders, the consequences were not only economic, but also social, since they had very few resources to withstand a drought period when they were not earning any income.

Another feature of vulnerability is its dynamic nature, which changes over time. Population growth, urbanization, economic development, deforestation and land degradation may directly affect the level of people's vulnerability to drought. Since the problems of land degradation and desertification are common throughout the LAC region, combating these issues, to achieve the target 15.3 of the Sustainable Development Goals (SDG) on land degradation neutrality will reduce vulnerability to drought and help build social and economic resilience to this hazard.

Political factors also affect the degree of vulnerability of a population. A political system that does not address poverty and inequality, unjust and informal labor relations or skewed land distribution is likely to increase the degree of vulnerability of the vulnerable groups to droughts and other disasters. Lack of access to education and high illiteracy rates also contribute to high vulnerability. Political systems in the region have often been unable to correct social inequalities and promote sustainable, equitable development that reduces vulnerability to crises.

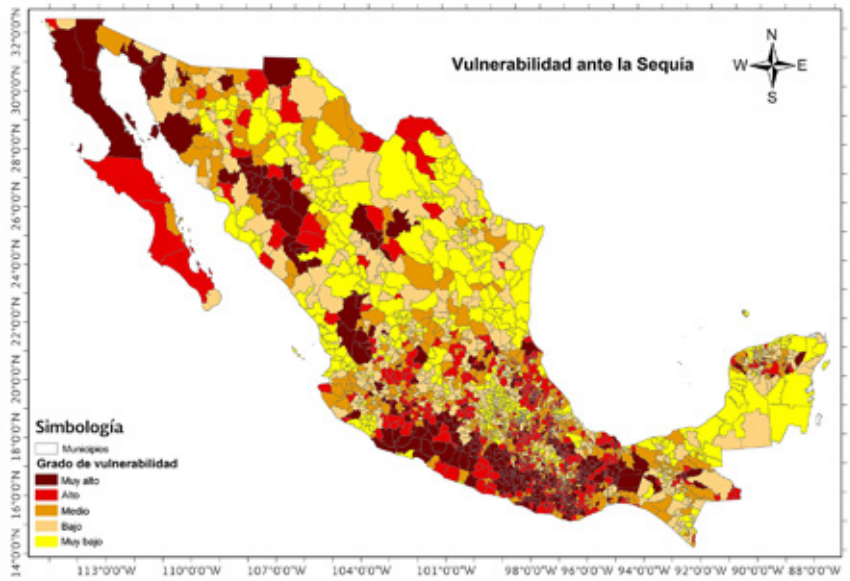
The level of vulnerability of a community is reduced by preparedness, which can take many forms. For example, community whose members are educated and better informed about the effects of drought will have a better coping capacity. A study conducted for Bolivia shows that municipalities that have a lower level of development and higher poverty rates are more vulnerable to drought than municipalities that have achieved a higher level of development (UDAPE, 2016). According to the same study, in Bolivia, socioeconomic vulnerability contributes to drought vulnerability more than exposure (16%) (UDAPE, 2016).

Map 4 shows maps of vulnerability to droughts prepared as part of the National Program against Drought (PRONACOSE) in Mexico. The maps are prepared as part of the PRONACOSE program. These maps are useful for allocation of fiscal resources from various federal programs aligned with PRONACOSE.

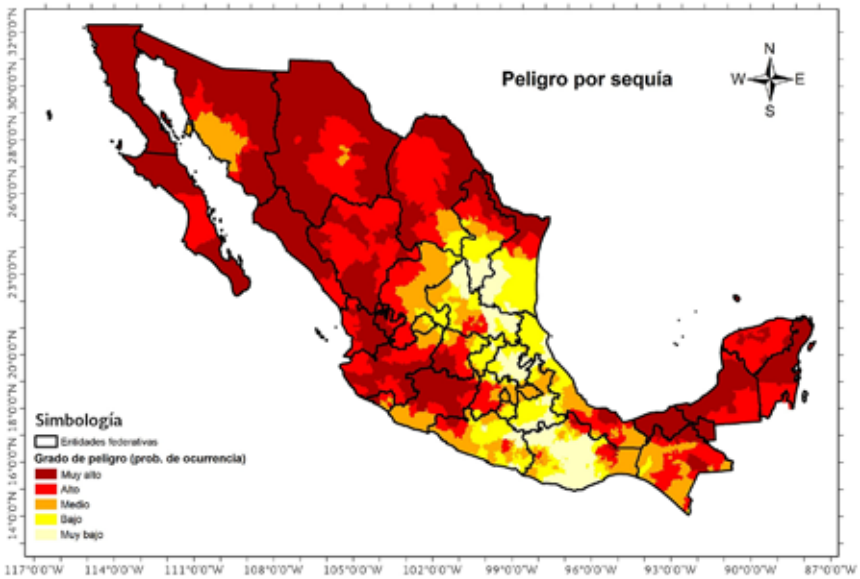
The maps were prepared by the Mexican Institute of Water Technology (Instituto Mexicano de Tecnología del Agua (IMTA). The methodology was designed to determine vulnerability, hazard and risk to droughts for each of the municipalities of the country, using municipal indicators.

Vulnerability is a multidimensional phenomenon represented by the incorporation of economic, social and environmental indicators used in the federal programs in the area that conforms the

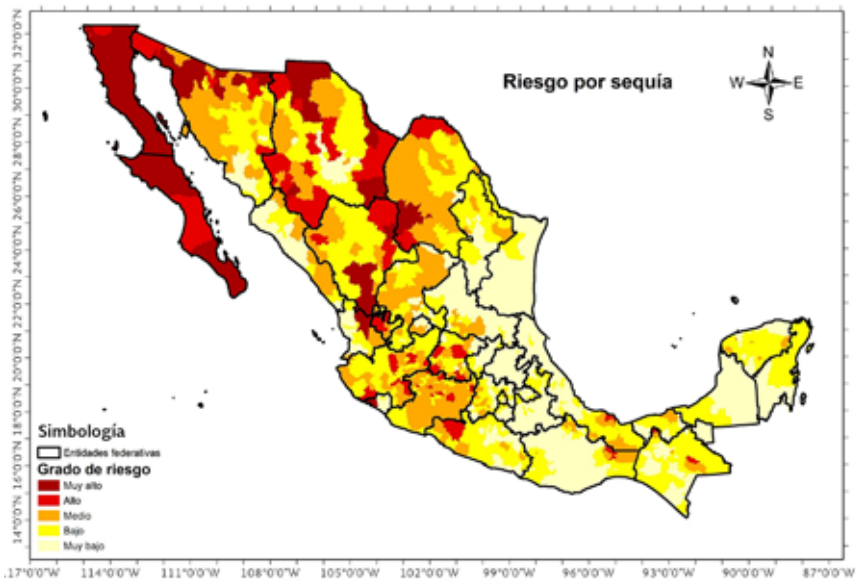
Map 4: Evaluation of vulnerability, hazard and risk of drought in Mexico.



Vulnerability to drought



Danger (probability of drought occurrence)



Risk = vulnerability x hazard

CIASI-Inter-Secretarial Drought and Floods Commission (Comisión Intersecretarial para la Atención de Sequías e Inundaciones). CIASI coordinates actions between federal agencies in risk analysis, prevention and mitigation of extraordinary meteorological events such as droughts and floods. The indicators provided by the federal agencies involve three components of vulnerability (exposition, sensibility, and adaptation capacity). They are classified as economic, social and environmental indicators. Together, they form global vulnerability and generate indices and maps at the municipal level for each type of vulnerability. These maps and indices are useful in the decision making process for risk reduction (Ortega-Gaucin et al., 2017).

The methodology was adapted and used in each of the 13 catchment agencies that belong to CONAGUA. This process involved capacity training-workshops, with the participation of representatives of the local catchment agencies and local agencies of CONAGUA. Consultants and researchers from state universities that participated in the preparation of Preventive and Mitigation Action Programs (PMPS) that are part of PRONACOSE also participated in the workshops.

Vulnerability can be addressed through public policies. The programs of cash transfer adopted in Mexico and Brazil have reduced the vulnerability to drought. The Brazilian program "Bolsa Família" guarantees a minimum income for families that keep their children in school and follow the state health care guidelines for children. The program has been so successful that creation of emergency employment during drought became unnecessary (Magalhães and Martins, 2016). Another example of a public policy addressing drought is the storage of water in large reservoirs. The National Department against Droughts (DNOCS) in Brazil supported the development of a large network of water reservoirs in the dry Northeast region to help reduce vulnerability. However, in case of large continuous droughts in 2016 and 2017, most reservoirs ran dry, and the country again was faced with vulnerability of water resources.

Economic, social and environmental Impacts

Droughts in LAC, as anywhere, impact every sector of society. A drought means less water coming from rains and snow to feed rivers, lakes, snow packs, aquifers and other resources that provide soil moisture and enable agricultural activities. In order to study the impacts of diminished precipitation and snow, we need to answer the following questions:

a. How intense was the climate variability? What was the percentage of reduction in precipitation compared to the regional average?

b. Where does the phenomenon take place and how is it distributed in space? How was the rain distributed spatially in the drought-affected region?

Table 2: Drought impacts in LAC.

Type/sector	Examples of negative impacts
Economic: agriculture	Loss of productivity in rain-fed agriculture Loss of production in rain-fed agriculture Loss of production in irrigated agriculture Loss of revenues in the water supply sector Loss of income in agricultural exports Loss of production of fish in internal lakes Reduction in tax collection by the government (and as a result, reduction in the capacity of the government to finance its activities) Increase in price of staple foods Reduction in industrial activities that depend on water supply
Social: people	Diseases due to low water quantity and quality Malnutrition Unemployment of rural workers Rural-urban migration (people fleeing because of drought) Fragmented families (for instance, due to migration of men, leaving women and children without means to survive) Conflicts around access to water resources
Environmental	Biodiversity loss Forest dieback Erosion
	Examples of positive impacts
Economic: industry, tourism	Production increase in the marine salt industry Increase in opportunities for the tourism industry in coastal areas Benefits for people associated with these activities

c. When did the drought occur? During which months and for how long? Was it a dry spell (a small drought within the rainy season), a year-long drought or one that lasted for several years?

d. What are the activities and the ecosystems that were affected? What were the most vulnerable sectors in the region? What made the ecosystem vulnerable to drought?

e. Which part of the population was affected the most? What made it particularly vulnerable and how many people were affected?

f. What activities and ecosystems were affected? How did the impacts of drought develop, starting with the shortage of rainfall?

g. What costs or economic benefits resulted from the impacts of droughts? If assessing the economic effects is challenging for some sectors, a potential qualitative assessment should be considered to give an idea of the scale of impact.

While any water-dependent activity may suffer from the impacts of droughts, there are two sectors that are impacted the most and are in need of effective early warning systems: one is agriculture (particularly subsistence agriculture) and water supply (including urban water systems) for humans and farm animals.

The IDMP National Drought Policy Management Guidelines (WMO/GWP, 2014) provide a checklist for historical, current and potential drought impacts. It lists more than 50 economic impacts including agriculture, livestock, water supply systems, food prices; a dozen environmental impacts including biodiversity, wild fires, water quality; and social impacts including health, nutrition, death, conflicts and inequalities that affect minorities, culture and migration trends. The list is not exhaustive and varies by location, its vulnerability and the intensity of the drought. A first version of the list was endorsed by the Institute for Policy Research of the Western Governors' Policy Office (WESTPO), of the United States, cited by Wilhite and Glantz (1985).

Most of the drought-related impacts are negative, but there are also some activities that can benefit from drought. Some examples of negative and positive impacts are listed in Table 2.

Examples of these impacts in LAC are described in Annex 1. In practice, the negative impacts significantly surpass the positive ones. Overall, droughts in LAC, as in other developing regions, cause a decrease in food production by small farmers. Decreases in production usually happen for the products consumed by the poor populations: beans, maize, manioc and other staple foods. This represents both an economic impact because of the production loss and a social impact due to many families losing their means of support and as a result affected by poverty, diseases and dependence on relief services. Additionally, unsustainable land use exacerbated by the effects of the drought can often lead to land degradation.

The analysis of the impacts is not always straightforward. For instance, a study of drought impacts for Ceará, a state in Northeast Brazil, has shown that the 1983 drought caused a decrease in public revenues, but due to government response which transferred resources to the affected population via work fronts, monetized transactions – and as a result, public revenues – have increased (Magalhaes and Glantz, 1992).

A first order impact of drought is on the availability of water for diverse uses, including urban water and sanitation systems. Initially, the dispersed population groups in rural areas with no water and sanitation systems are affected the most, since they have to fetch water further away – a job usually done by women and children. If a drought persists, there is no water to supply municipalities, cities and other water users. In prolonged droughts such as the one that hit LAC between 2012 and 2016 (in several countries), even big cities such as La Paz and Caracas that normally have access to large water sources have been affected.

The lack of water for livestock herders and pastoralists is also a common problem. If there is a drought, small reservoirs are not replenished and cattle die of thirst or sold at very low prices. The decreased soil humidity and lack of irrigation, which also depends on water supply, means that many farms can no longer grow fodder, and cattle die of hunger. Cattle carcasses along the roads in certain parts of the region during drought are still a common sight. The loss of cattle during drought means major economic costs, and the impact on small cattle growers is more severe, because they have very limited resources.

What is being done?

A large number of drought studies already exist, including assessments of vulnerability and impacts in the LAC region. In 1980s, some pioneering studies were sponsored by UNEP – United Nations Environment Program, following the increasing interest on issues of climate change. One of the studies was done by International Institute for Applied Systems Analysis (IIASA), headquartered in Austria (Parry et al, 1988). The study, called "The Impacts of Climatic Variations on Agriculture," published a volume on semi-arid regions of the world, including two case studies for LAC, one for Ecuador (Bravo et al, 1988) and another one for Northeast Brazil (Magalhaes et all, 1988). Another study, also done for UNEP during that time, covered various sectors of the economy and society of Brazil and was called "Social and Economic Impacts of Climate Variations and Governmental Responses in Brazil" (Magalhaes & Bezerra Neto, 1991).

In 1992, in preparation for the UN Summit on Environment and Development (Rio 92), an International Conference on Impacts of Climate Variations in Semi-arid Regions was held in Fortaleza, Brazil, presenting several case studies of LAC and other regions (ICID 1992). Since

then, a large body of work on the subject has been produced by various universities and research centers in several countries of LAC. A recent study made by the Center for Strategic Studies and Management (CGEE) has shown that in Brazil, about 5,000 researchers are focusing on issues related to the semi-arid regions, including different aspects of droughts (CGEE, 2014). The researchers have produced reports, dissertations and theses on aspects of droughts, in particular on climate impacts and responses. Such studies, however, are sparse and not coordinated, and there is no synthesis that combines their main findings to inform policy makers. Therefore, no specific initiative exists to guide the future research efforts and link them to policy makers, with the probable recent exception of Mexico.

In 2015, the government of Mexico has developed a Master Plan on Drought Research (Plan General Maestro Estratégico de Investigación), a research program on meteorological, hydrological, agricultural, and socioeconomic aspects of drought, in order to support the National Program against Droughts (Programa Nacional contra las Sequías – Pronacose). The research program is implemented by the National Water Commission (Conagua – Comisión Nacional del Agua) and other government institutions and is financed primarily by the National Council on Science and Technology (Consejo Nacional de Ciencia y Technología – Conacyt). Results of the program are not yet available.

Methodologies of impact studies

Existing studies follow different methodologies. The central question is the relationship between climate variability and social, economic or environmental variables. Sometimes, while the relationship may exist, it cannot be attributed to a certain climatic event. For instance, a decline in the production of beans can be attributed to a drought or to a behavior change in farmers who may have decided to plant a different crop or not to plant at all. In general, however, if a fall in agricultural production or productivity occurs during a drought year, that effect may be attributed to the variability of climate, but it is necessary to examine other factors that may have influenced the results.

There are two groups of methodologies: a quantitative methodological approach and a qualitative analysis. The quantitative approach, attempts to link different climate and production variables – for instance, precipitation and agricultural production. Quite a few studies adopt this method. Recently, for instance, Bastos (2016) studied the relationship between climate variables and agricultural production in Northeast Brazil (De Nys et al, 2016) and found a positive relationship between changes in weather and the fall in production and productivity during drought years. Quantitative models also permit to evaluate the costs of the impacts. According to Bastos (2016), drought caused a loss of 20 per cent in the value of agricultural production in the Northeast, during the 2012-2014 periods. Quantitative analysis allows for different levels of complexity, from simple econometric models using one equation to multi-variable models, sometimes using large software systems for data analysis and statistics such as Stata and SAS.

Another methodology includes different types of qualitative analysis, generally based on statistical data and the opinion of experts, often combined with real-life examples and case studies. This kind of methodology can show the correlation between lower precipitation and loss of agricultural productivity during a certain period, or confirm the link between low precipitation and water deficit.

Studies of impact can also be conducted to assess possible future scenarios such as climate change that take into consideration the outcomes of General Circulation Models (GCM), under hypotheses of different concentrations of CO2 in the atmosphere, as defined by the Intergovernmental Panel on Climate Change (IPCC). According to IPCC, in the future, droughts are likely to be more severe in semi-arid regions, where temperatures will be highest, accompanied by greater evapotranspiration and less soil moisture, with greater pressure on water supply and agriculture (IPCC, 2007, 2014). The Paris Agreement, approved by the UNFCCC in 2015, establishes the necessity to increase the ability to adapt to adverse impacts of climate change and foster climate resilience (Paris Agreement, art. 2), which will require the development of the knowledge base on future climate impacts. This includes assessing the potential impacts of severe droughts triggered by climate change. In fact, several studies have shown that it is possible to forecast climate change based on the information about present and past climatic events (Glantz, M. 1998). The main differences in nature of extreme events of droughts in the future are likely to be higher temperatures and higher evapotranspiration rates.

Methodologies of vulnerability studies

Only a small number of vulnerability assessments for the LAC region exist. Since vulnerability is a complex issue that cannot always be assessed in statistical terms, applying quantitative approach based on mathematical or statistical treatment of data to assess vulnerability, can be much more challenging than trying to quantify drought impacts.

One of the most complete studies on drought vulnerability was carried out for Europe by a group of scientists from the Universidad Complutense de Madrid, the Albert Ludwig University Freiburg, and the Universitet Oslo (De Stefano et al, 2015). This study approaches a vulnerability assessment as "a process of identifying, quantifying, and scoring the vulnerabilities of a system, "which can be a region, a catchment, with a population, economic and social activities and environment."

Most studies consider two types of vulnerability: one that is caused by current climate variability, the other one – by future climate change. The Europe study, similarly to other vulnerability studies, are mostly based on the definition of vulnerability on the

IPCC – Intergovernmental Panel on Climate Change (IPCC, 2007; Adger et al, 2007; De Stefano, 2015), according to which the risk of impacts is a function of the characteristics of the drought, of vulnerability and of adaptive capacity. The components of vulnerability, such as exposure and sensitivity, lead to potential impacts (economic, social and environmental). Combined with the adaptive capacity, this determines the degree of vulnerability to droughts. Once the relationship is established, the question that remains is how to find the data for each component and produce a final indicator of vulnerability, which can be high, medium or low. It is not always easy to measure exposure, sensitivity and adaptive capacity along with some of the impacts. One problem is how to interpolate data when necessary and how to compare different units – for this reason, it may be necessary to normalize all data variables, assuming a value between 0 and 1.

Another study was done in Bolivia by the Ministry of Development Planning, the UNPFA and UDAPE (UDAPE, 2015). This study calculates population vulnerability to different types of disasters, including droughts, in each of the municipalities of Bolivia, combining qualitative analysis and quantitative methods that use census data. The study considers the following factors of vulnerability: exposure, people requiring assistance, living conditions, health and educational infrastructure, differences in social groups (such as ethnicity), and access to information. Variables are identified and calculated for each type of factors and vulnerability indices are built for each type of disaster at the municipal level.

It is possible that in the future, complete studies of vulnerability can be conducted for the LAC region. In the meantime, more basic studies that would consider the region as a whole, or sub-regions, countries, sub-national regions, states or provinces, should be implemented. In each case, the study would try to answer questions such as what population groups, sectors and activities are vulnerable, and why. As a result, a regional map presenting these values could be produced.

Options for drought policies

Studies of vulnerability and impact are essential elements of a drought policy. It is necessary to support and expand these studies, using diverse methodologies to create an accurate representation of a certain place, sector or product affected by drought.

In the context of a proactive drought policy, communication between researchers and decision makers is important. The appropriate solutions may vary from region to region. For example, the IPCC produces a summary for policy makers synthesizing the findings and recommendations from each general report. Such a synthesis for policy makers, showing conclusions and recommendations in regard to vulnerability and drought impacts at different policy levels: can be prepared once a year or biennially and disseminated at meetings, workshops and through the media.

To enhance and summarize knowledge on vulnerability and impacts of droughts, and link it to the decision making process, it is important to take advantage of existing capacities and institutions, as well as allow for regional and inter-regional cooperation within and outside the region.

Besides the content of the investigations on drought and their impacts, it is necessary to define the participating institutions, their roles and the need for capacity building in the context of each country. International cooperation, including the role of development and financial institutions, is paramount to assuring the support for research and access to international experiences.

Financing of activities on vulnerability, impact and drought risk studies may come from several sources. In general, countries have a system to support research, as the case of national science councils in LAC (for example, Conacyt in Mexico and in Argentina, Concytec in Peru and CNPq and Capes in Brazil). Research programs supported by the science and technology institutions should receive continued support, along with other national and international knowledge providers.

Pillar 3: Mitigation and Response

The third pillar of the National Drought Policy focuses on mitigation and response strategies. It fulfills the final objective of National Drought Policy. Pillar 1 and 2, presented in the previous sections, support Pillar 3 with information on droughts and their impacts. These inputs are important for the preparation and implementation of national drought policies and programs.

Pillar 3 has the objective of organizing, planning and implementing mitigation and response strategies by utilizing appropriate institutions, technical capacity and financial resources, including bilateral, regional and international cooperation.

Mitigation and response are the two kinds of drought policies included in Pillar 3. Mitigation involves all policies and programs that aim to reduce future vulnerability to drought as well as the risk of drought impacts, along with increasing resilience to future droughts. The definition of mitigation, in this context, is different from the one used by the climate change community, where mitigation refers to the reduction of CO2 emissions. However, the two meanings are similar in that they refer to minimizing the negative effects of environmental events.

The drought response aims at alleviating the impacts of ongoing droughts. Once the event

is occurring, society and government need to react to protect those population groups who are most vulnerable to drought and who suffer its negative impacts. In order to help the population better cope with the situation, drought response also requires preparation plans, so that government and society are ready to act when the disaster strikes.

While reacting to drought events has been the standard approach to fighting the effects of drought, it often leads to emergency responses crowding out mitigation strategies, since helping people affected by disaster becomes the utmost priority and requires all available resources. In developing countries, where these resources are more limited, droughts not only lead to major economic losses, but also cause enormous social challenges, imposing hardships on the poorer population groups. If the drought policy is thought of as a continuous approach, then there is more time to plan adequate mitigation options and prepare better response strategies.

Proactive mitigation and response strategies are instrumental to the so-called "hydro-illogical" cycle, a term coined by Professor Donald Wilhite, of the Nebraska University (Wilhite, 2016). In the illogical cycle the society, including policy makers, forgets about the drought once it ends, and acts as if the drought would never return again. One key element of a proactive drought policy is approaching drought as a recurring event whose exact time cannot be predicted. While this approach is widely understood, this understanding has not yet resulted in behavioral and institutional changes in drought-related planning and policymaking. This paper is intended as a contribution to facilitating the acceptance of this approach.

Mitigation strategy

Mitigation policies require first and foremost the understanding of vulnerability causes and impacts – the information provided in Pillar 2. Pillar 1 provides the understanding of the drought situation itself. The additional information required to plan and implement programs and projects that form Pillar 3, can be obtained from other sources, especially the local ones.

As discussed previously, drought impacts all sectors of society, including cattle-raising, mining, sanitation and manufacturing, and adequate responses should be available for each sector. However, in most regions the effects of drought are the most dramatic in the water resource and rain-fed agriculture sectors. Drought means a reduction in the rainfall that feeds the water cycle, involving rivers, lakes (in the context of drylands, mainly artificial ones) and aquifers. Water supplied by these sources is utilized by multiple water users for various purposes. One of the main uses is for human consumption in cities. A drought may cause the reduction in quantity as well as quality of water in the reservoirs – an issue big enough to require a proactive response that can build society´s capacity to cope with future drought episodes.

A more immediate problem may be to provide water for dispersed consumers in the rural areas, where there is no big storage capacity. This rural population usually depends on fetching water in the nearest water source. With the drought, they have to fetch water at longer distances, and this is a work that most of the time is done by women and children. This is also a big issue that has frequently been responded to during drought episodes. In Northeast Brazil, for instance, the federal government maintained about 8 000 water tank trucks to distribute water to dispersed rural populations, during the drought year of 2016. This solution has been common in all of Latin America. But now, with the aggravated conditions of a long multi-year, back to back drought, tank trucks need also to supply some urban water systems.

Increasing the water supply that has been diminished by drought is a major challenge. Federal, state/provincial and municipal authorities may consider increasing the capacity of aquifers, digging new wells, or to building new aqueducts to link water users to more remote water sources. When developed well in advance, these solutions cost less and are more effective.

In Brazil, the development of water storage capacity in the semi-arid zones has been a long-time strategy to help reduce water vulnerability. Today, there is large network of dams, that can provide a reliable supply of water during droughts that last one to two years. However, during longer droughts such as the one in 2010-2017, the system may fail, necessitating water rationing, locating new sources of water and increasing the efficiency of water uses by reducing losses in urban systems or reusing water and moving to more water-savvy irrigation practices.

The rain-fed agriculture is also directly affected by drought – in fact, some experts insist on using a more specific term "agricultural drought" instead of more generic "drought". The reduction in water supply causes an immediate reduction in soil moisture and the production of rain-fed crops. In the poorer LAC regions, the downturn in agricultural activities causes immediate unemployment and loss of income for millions of small farmers and rural workers, exacerbating social problems and increasing poverty. This requires society and government to promote actions that help agriculture better cope with drought. Among such measures are insurance programs that cover the drought-related losses in agricultural production and initiatives that promote new research that builds drought resilience, such as Embrapa program by the Brazilian Agriculture Company (Sá and Silva, Eds, 2010). The program focuses on developing new drought-resilient crop varieties and new production systems that are better able to cope with higher temperatures and require less water.

There are a number of programs in the region, aimed at combating desertification and recovering degraded land that can also bring multiple benefits including increased capacity to cope with drought, as well as

protect biodiversity and increase carbon storage. The Hydro-environmental program (Prodham) in Ceará, Brazil, developed by the Secretariat of Water Resources of Ceará (SRH) and Funceme – Ceará Foundation of Meteorology and Water Resources (Marques and França, 2010), focuses on the restoration of soil, increasing water retention capacity and recovering biodiversity. Local knowledge and participation are key elements of this type of programs, and the resulting technologies can be further applied to combat desertification on vast expanses of degraded land region-wide.

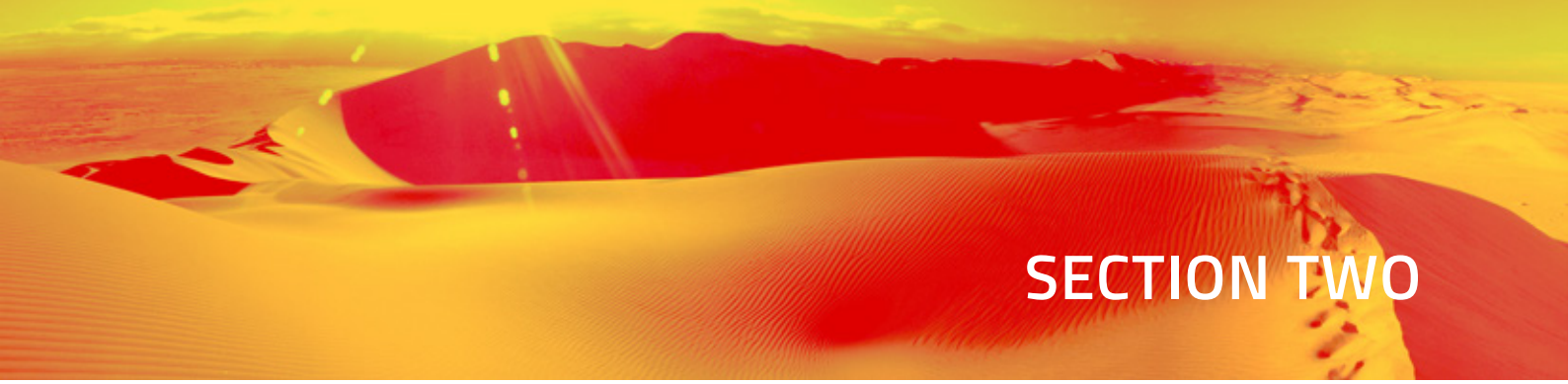
Irrigated agriculture has become an economically important sector of the economy across the LAC region. While short-lived droughts usually do not affect irrigation systems, a multi-year drought can have a large-scale impact on the irrigated agriculture production, affecting the supply to the national and international markets. One of the potential solutions is the Integrated Water Resources Management (IWRM) that focuses on optimizing water supply and demand. While IWRM has been prominent on the drought resilience agenda in the last two decades with significant progress achieved, much more remains to be done. Proactive drought planning should become an integral part of the national, regional and state integrated water management system.

Moreover, policies, programs and projects aimed at reducing future vulnerability to drought should always be considered in the context of sustainable development policies, since they are linked to the improvement of living conditions and livelihoods of vulnerable populations. The synergies between drought policies, sustainable development policies and the achievement of the sustainable development goals should be utilized by any new or existing initiative.

Drought response

When the drought occurs, there is a need for immediate response that minimizes the social, economic and environmental costs of the disaster. Normally, governments need to deal with the most dramatic impacts of the disaster: diminished water supply, reduced income, lost agricultural production, inadequate food supply and the need for emergency health services. Often, the required actions are defined after the drought has already been declared, with no time left to consider the results of evaluation studies and impact assessment, or to evaluate the effectiveness of drought policies. To ensure that the measures are effective and the country learns from experience to better prepare for the next drought, the national drought policy or plan must include all of the three pillars presented in this paper.

Proactive drought preparedness plans for droughts should be developed at various scales: spatial (region, state or province, municipality or river basin), and sectoral (water, agriculture, industry and infrastructure). Each plan defines the level of risk tolerance and associated measures to be taken (Assis et al, 2016). This way, planned actions will be triggered automatically once certain indicators are achieved, without the need to wait for a political directive. Having preparedness plans in place will also facilitate the use of external resources, such as national emergency response programs, including those that are part of the civil defense system.



SECTION TWO

DROUGHT PREPAREDNESS AT NATIONAL LEVEL

In several LAC countries, the responsibility of providing resources to address natural disasters including droughts lies mostly with federal governments. The federal support comes through the civil defense systems in cooperation with provinces, states or municipalities. In Brazil, after the federal government recognizes a situation of public calamity in a state or municipality, it starts to promote and support appropriate relief actions. Similar systems exist in several other countries of the LAC region. In central states, emergency policies and programs are implemented directly by the central government.

In larger countries, the federal budget is the main source of financing for drought relief actions. However, some less developed and small countries do not have adequate resources to cover the costs of relief programs and require external support of regional, international or bilateral institutions.

There can be local preparedness and contingency programs to be implemented during the drought that include some actions that do not depend on federal funding, such as triggers related to water management or actions that can be taken by local communities. However, these local initiatives can receive the support of federal programs when necessary.

While best-case scenario described in pillar 3 recommends that there are local preparedness plans for states, hydro basins, municipalities, water and sanitation services, and water reservoirs plans, these preparedness plans are not always available. If this is the case, federal-level program may be implemented in coordination with states, provinces and municipalities. In Brazil, the water distribution for the Northeast drought-stricken region is implemented directly by the federal government, through the ministries of national integration and defense, in coordination with states and municipalities, with extra 8,000 water-tank trucks dispatched in 2016, in addition to those financed directly by states and municipalities.

In addition to national programs under the civil defense system, the federal government may also promote development actions in the drought-affected regions with the aim of reducing vulnerability to future droughts and promoting economic as well as social development. Most countries now agree that these actions should promote sustainable development, following the goals and targets of the SDGs defined by the United Nations (United Nations, 2012). It is also suggested that drought plans should be coordinated or considered as part of national action plans (NAPs) to combat desertification, which each country prepares under the framework of the UNCCD.

The objectives of reducing vulnerability and increasing the ability of the population to face the drought impacts should become a dimension of all regional development programs and projects within the framework of sustainable development. The development of environmental and social safeguarding mechanisms linked to the sustainable development goals through any program supported by the federal, the states/provinces and municipal governments as well as the private sector should become an overall priority.

SECTION THREE

INTERNATIONAL AND REGIONAL COOPERATION

International, regional, bilateral and south-south cooperation play a very important role in translating technology, resources and experiences into drought management planning and implementation measures. While less developed countries (LDC) are the primary focus of this cooperation, the issue will require the involvement of every country in the world, If effective exchange of experiences and know-how for drought management to be achieved.

Drought policies at the national, regional and local levels are a responsibility of each country and must be formulated from regional and local points of view, involving national and local technical capacity. A special role in this process should be reserved for local, community and indigenous knowledge that can contribute to better drought adaptation, mitigation and response policies. While there is a substantial institutional, technical and human capacity in the region, it is not equally distributed throughout LAC.

International cooperation can develop in the financial as well as technical sphere, including the transfer of knowledge and technologies. The financial cooperation can be promoted through such international finance institutions as the World Bank (IBRD), the Inter-American Development Bank (IADB) and the Development Bank of Latin America (CAF, former Corporación Andina de Fomento). The financial support of development projects can be accompanied by technical cooperation, capitalizing on the advantageous position of these institutions to access and promote international exchange of knowledge. For instance, a technical assistance project of the World Bank allowed the exchange of cooperation between Brazil, Mexico, Spain and the USA, including knowledge institutions such as the National Drought Mitigation Center (NDMC) of the University of Nebraska in the United States and the Water National Commission (Conagua) of Mexico.

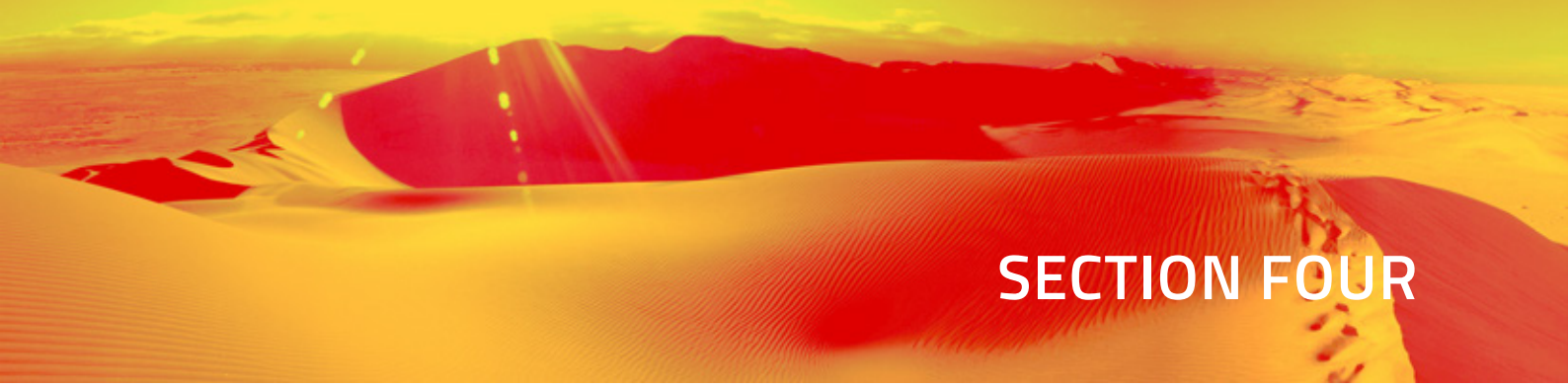
The United Nations institutions such as FAO, WMO, UNCCD, UNDP, UNEP, UNESCO and ECLAC are also an important source of technical cooperation and have been active in Latin America and the Caribbean. International cooperation should also consider regional initiatives such as Mercosul, CELAC and Caricom.

WMO together with the Global Water Partnership (GWP), created the Integrated Drought Management Program (IDMP) to provide assistance to countries and regions. Through its Help Desk, the IDMP can provide interested countries access to a large body of knowledge on drought policies and other drought planning resources worldwide. The NAP that each country submits to the UNCCD is also a valuable resources that presents the drought situation and resources for each country.

At the regional level, institutions such as the Organization of American States (OAS) and the Inter-American Institute for Cooperation on Agriculture (IICA) have been active in supporting development projects in drought-affected areas of economy, such as agriculture and water resources.

Bi-lateral cooperation is also very important for countries outside and within the region. Countries such as France, Germany, the United States and the United Kingdom are active in bi-lateral cooperation and have a long history of bilateral cooperation with the LAC countries. Within the region, technical cooperation is also a priority. For example, Brazil has a dedicated technical cooperation agency that prioritizes cooperation projects in South and Central America and in the Caribbean (ABC, 2017).

It should be emphasized that technical and financial cooperation is not a matter of simply adopting external technologies and knowledge, but rather blending them with local, indigenous and community knowledge to address national and local requirements. The policy that is developed and implemented nationally and locally needs to utilize the local capacity and encourage local ownership of the drought mitigation and adaptation programs. Though the framework of the drought policy can be similar across the regions, the details of the concrete measures must be adapted to the local conditions and reflect local and native knowledge. Therefore, technical and financial cooperation is not meant to substitute local knowledge and capacity, but rather to complement and strengthen them.



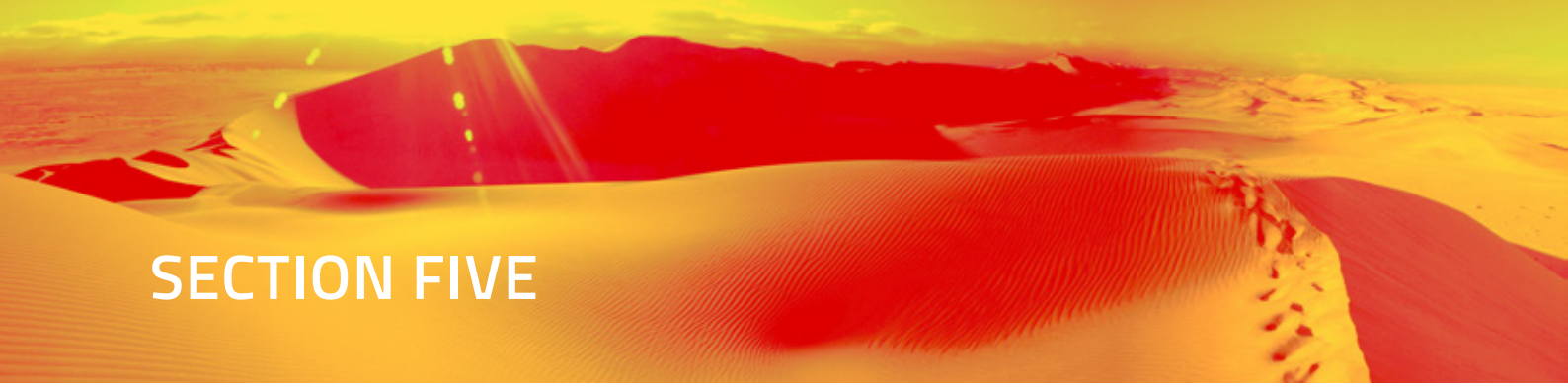
SECTION FOUR

THE TEN-STEP PROCESS AND THE THREE-PILLAR STRUCTURE

The ten-step process, proposed by Wilhite et al (2000, 2005) and included in the IDMP Policy Guidelines (WMO/GWP, 2014) is recommended for the adaptation to the conditions of each country or region where it is applied. It outlines actions to be considered in the planning and implementation of a drought policy. Table 4 presents the ten-step methodology for the drought strategy suggested in this document, according to the HMNDP guidelines. Each step of the process contributes to one or more parts of the Strategy. For instance, steps 4, 5, and 8 are included in the preparation of Pillar 1. Some of the steps may be more applicable than other in each specific case, and some steps not mentioned initially may become necessary later in the process.

Table 4: Drought policy and the ten-step process.

Type/sector	The corresponding steps
Pillar 1 Drought information: monitoring, forecasting, early warning	4 – Inventory data and financial resources available and identify groups at risk 8 – Publicize the national drought management and preparedness plans: build public awareness and consensus 5 – Prepare key points of a national drought management policy and preparedness plans, including the following elements: monitoring, early warning and prediction, risk and impact assessment; mitigation and response
Pillar 2 Impact and vulnerability assessments	4 – Inventory data and financial resources available and identify at-risk groups 6 – Identify research needs and fill institutional gaps 7 – Integrate science and policy aspects of drought management 5 – Prepare the key points of a national drought management policy and preparedness plans, including the following elements: monitoring, early warning and prediction, risk and impact assessment; and mitigation and response
Pillar 3 Mitigation and response	5 – Prepare the key points of a national drought management policy and preparedness plans, including the following elements: monitoring, early warning and prediction, risk and impact assessment; mitigation and response
Development of a national drought policy	2 - Define the goals and objectives of a risk-based national management policy 5 – Prepare the key points of a national drought management policy and preparedness plans, including the following elements: monitoring, early warning and prediction, risk and impact assessment; mitigation and response
Institutional dimensions	1 – Appoint a national drought management policy commission 5 – Prepare the key tenets of the national drought management policy and preparedness plans, which would include the following elements: monitoring, early warning and prediction, risk and impact assessment; and mitigation and response
Participation	3 - Seek stakeholder participation; define and resolve conflicts between key water use sectors, considering also trans-boundary implications 8 – Publicize the national drought management and preparedness plans and build public awareness and consensus 9 – Develop educational programs for all age and stakeholder groups



SECTION FIVE

INSTITUTIONAL, FINANCIAL AND GENDER DIMENSIONS

Coordination, implementation and stakeholder participation

Institutional arrangements are key to the planning and implementation of all policies, especially those related to drought. These policies can involve national or even global elements, such as climate, and local dimensions, such as impacts, mitigation and response strategies. In fact, the impact of droughts is mainly local, while climate is a global phenomenon. To be effective, a drought policy must be based on a comprehensive legal framework and solid institutional arrangements that identify relevant institutions at the national level (as well as at the sub-national level, in the case of federal states) and strive to create and strengthen regional systems of climatic information, including monitoring, prediction and early warning. A drought policy may be a stand-alone policy or part of a broader context of disaster risk reduction, climate change adaptation, water resources, agriculture and sustainable development. Financing for these initiatives can come from both national and international sources.

Coordination

One key characteristic of the drought policy is that it must be inter-sectoral and intergovernmental. No ministry, department, or government institution can assume the sole responsibility for the entire menu of drought policies, since it involves actions that are under the command of various sectors and jurisdictions.

For a national drought policy to be successful, the institutional arrangements need to be clear and well defined. All stakeholders need to clearly understand their roles and responsibilities, so that there is complete clarity on the decision and the implementation processes. Thus coordination is key element of the successful inter-sectoral cooperation.

Many institutions and stakeholders involved need to be represented according to their specific roles within a shared platform where all decisions on the drought response must be discussed and approved, with the implementation delegated to the sectorial entities.

A platform that brings together all decision makers should exist on a permanent basis, not just during the periods of drought, since drought planning should become a continuous process, with the drought commission being active during the non-drought periods as well. This function can be delegated to and existing government body, however, it needs to be knowledgeable on the drought issues. In addition to a national commission that serves as a center to oversee all the policy components combined, there should also be a specific committee for each of the policy pillars.

In a nutshell, a drought policy in each country should rely on effective institutional arrangements that include:

1. A coordinating mechanism at the highest level to adopt important decisions and regularly follow up on the policy implementation. This role can be assumed by a national commission or committee, provided that:
   a. It is at decision-making level
   b. It is inclusive of all relevant stakeholders (ministries, other agencies)
   c. It has a Secretariat that can prepare each decision and follow up
   d. It meets regularly (meetings could be less frequent in non-drought years, but the body should be active on a permanent basis)
2. Implementation through ministries or departments of respective organizations, and
3. Through subnational governments and municipalities, in the case of federal states, or directly by the central government, in central states.

Implementation

The detailed planning and implementation of the various aspects of a drought policy are the responsibility of the designated sectoral ministries. Each sectoral ministry or department must maintain the necessary technical and financial pre-requisites for the implementation of the relevant programs and projects.

It must be noted that in the case of LAC, many countries already have drought policies, in various stages of implementation. Existing mechanisms need to be considered, and their strengths and shortcomings evaluated before appropriate institutional arrangements for each country can be developed, following national regulations and taking into account national specifics.

Capacity building

Planning, implementation and evaluation of drought programs and projects, including monitoring, climate prediction, drought early warning, vulnerability and impact evaluation, as well as mitigation and response actions, require a competent human resources base in each of the LAC countries, as well as region-wide. Therefore, capacity building is an important dimension that needs to be addressed on a continuous and permanent basis, since knowledge needs to be constantly updated.

Capacity building for the development of drought policies and programs is an interdisciplinary challenge, that should be addressed at both national and local levels, involving not only climate and meteorology aspects but social, economic and environmental dimensions as well – for example, poverty, agriculture, land and water resources.

Participation and gender

To be sustainable, the discussion and implementation of drought policies needs to include all stakeholders with the outcomes recognized by everyone involved. The participation can take place at various levels: the involvement of government and experts can happen through national and sectoral committees that can also invite the representatives from the academia, the civil society and the affected population, local communities and especially underprivileged groups such as indigenous peoples, women and youth.

Sources of financing

The costs and sources of financing for actions that comprise a national drought policy are not always easy to forecast. Possible sources of financing can include the national budget (this is the common source in large countries), within the subnational governments and as part of international cooperation and financial aid. The source of funds also depends on the type of action – for instance, relief response during drought, versus investment in water infrastructure aimed at reducing future vulnerability to droughts. In addition to aforementioned sources, engaging the private sector in drought-related initiatives is another source of support for a national drought policy.

Evaluation

An evaluation of plans, programs and projects included in a national drought policy should be done regularly with results submitted to the national coordinating body. A national drought policy may be disaggregated into several actions, programs, and projects, with a separate evaluation for each section. In this case, the results should be combined, presented for the discussion of all with stakeholders and disseminated to the general public.

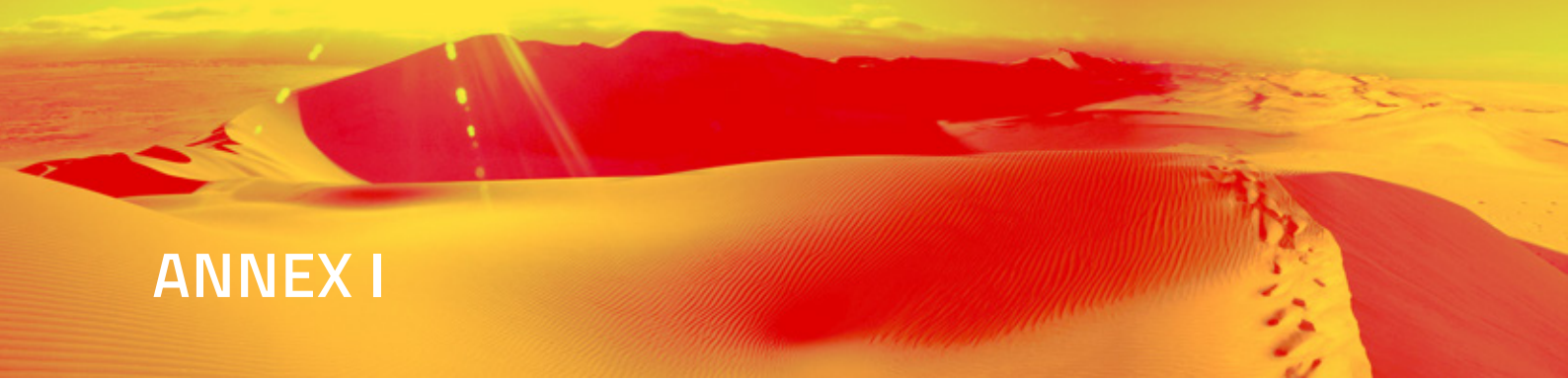
The evaluation should verify progress towards the objectives of the policy or program, confirm appropriate allocation of resources and provide recommendations for further improvement of the policy.

Final remarks

The presented paper serves to emphasize the need for proactive drought policies in LAC countries. All areas of LAC are subject to drought, and the poor are the ones that suffer the most from the negative effects of the disaster. This paper presents a way to reduce vulnerability to drought by building a strong national drought policy that follows the recommendations of HMNDP and involves the three pillars of monitoring, and early warning; vulnerability and impact assessment; and mitigation and response. Well-planned and thoroughly implemented national drought policies may reduce disaster impacts as well as the need for resources presently allocated to financing reactive drought policies.

High-level political commitment is the key element of the design and implementation of a drought policy. Many times, political will is the result of the disastrous effects of the drought, when resulting losses and deaths demand the attention of policy makers. This is also the reason why drought policies have been mostly reactive. However, as shown in this document, there is a need to harness the momentum of high drought awareness to plan and implement proactive drought policies that will result in decreased vulnerability and need for relief actions. The investments required to design and implement pre-emptive drought policies are far below the costs incurred when only reactive measures are in place to address the impacts of drought.

National drought policies should be implemented region-wide with the support of international organizations such as UNCCD, WMO, FAO and The World Bank and others. Regional organizations should share knowledge on drought-related programs and technologies, supporting national and sub-national drought preparedness initiatives.



ANNEX I

DRYLANDS AND DROUGHT IN LAC

Droughts occur in every region of the world, regardless of their climate regimes. However, their impacts tend to be more dramatic in drylands, especially in semi-arid regions, which can be classified marginal areas where drought and poverty collide, as suggested by Ribot et al (1996). These areas are commonly home to populations highly vulnerable to the impacts of droughts, since their main economic activity is rain-fed agriculture. According to the IPCC Fifth Assessment Report (AR5), in the future, the dry regions are likely to experience more severe and frequent drought due to climate change (IPCC 2014).

Aridity indices

Drylands have been defined by different measures such as the UN Environment Aridity Index (AI) – an annual rainfall and evapotranspiration ratio, and the Aridity Regime (AR) – a ratio between rainfall and evapotranspiration that also considers the duration of the dry period (UNESCO, 2010). According to UNESCO (2010), in the AR, a month is rated as dry if the P/ET (precipitation/evapotranspiration) ratio is less than 0.5 and a dry period duration is the number of months in the year that fulfills this condition. For instance, if the evapotranspiration ratio in a region stays below 0.5 for seven to eight months each year, it is classified as a semi-arid region (Table 5).

The main difference between the Aridity Index (AI) and the Aridity Regime (AR) is that while the Aridity Index considers the annual ratio P/ET to classify climatic regions according to the values of the ratio, the Aridity Regime considers the number of months in which the same ratio is below 0.5. Some regions that are classified as dry in the AR may be considered as wet sub-humid in the AI (see Map 1).

The UNCCD uses the UN Environment Aridity Index to classify as drylands all regions where annual relation between precipitation and evapotranspiration falls below or equal to 0.65 and above 0.05.

Results presented by UNESCO (2010), based on the Aridity Regime, show that all arid zones (including arid, semi-arid and sub-humid – both dry and wet) in the LAC region cover the total area of 7.279.053 km^2, or approximately 36 per cent of the entire area of the region. Some countries such as Argentina, Mexico, the Netherlands Antilles, Barbados, Turks and Caicos, Antigua and Barbuda, Aruba and the Anguilla Islands have over 60 per cent of their land in arid zones. Brazil, Argentina and Mexico have most of the arid zones with 29 per cent, 26 per cent and 18 per cent of all LAC arid area, respectively. Overall, most countries have at least 20 per cent of their total area within arid zones.

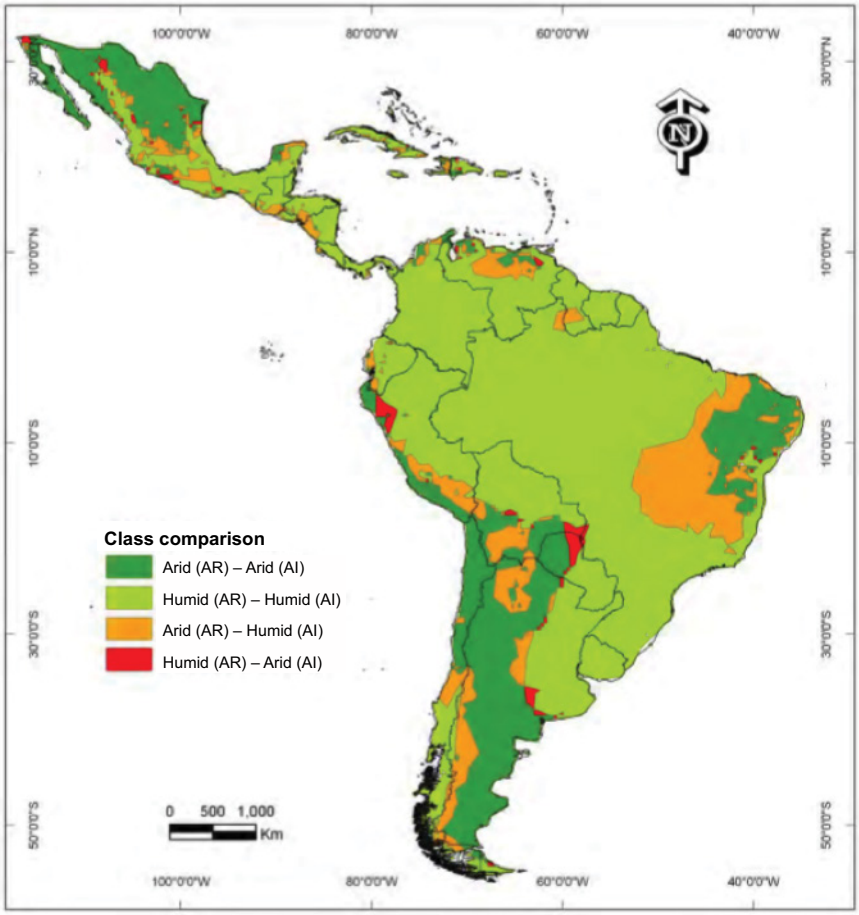
Table 5: Aridity indicators

Aridity index	Ia = P_a/ET_0
Hyper-arid	<0.05
Arid	0.05 to 0.20
Semi-arid	0.20 to 0.5
Dry sub-humid	0.5 to 0.65
Humid sub-humid	0.65 to 1.0
Humid	>1

Aridity regime	Conditions
Xeric	12 dry months & Ia<0.05
Hyper-arid	11 – 12 dry months
Arid	9 – 10 dry months
Semi-arid	7 – 8 dry months
Sub-humid	5 – 6 dry months
Humid	3 – 4 dry months
Hyper-humid	1 – 3 dry months
Hydric	0 dry months & Pa (Annual precipitation) < 2500mm
Hyper-hydric	0 dry months & Pa > 2500mm

Source: UNESCO (2010)

Map 5: Classification of differences and overlaps observed within the climatic group under the Aridity Index (AI) and the Aridity Regime (AR).



Source: UNESCO (2010)

Map 5 compares the areas of the drylands of LAC according to the AI and the AR indices.

Using the aridity index definition, Table 5 shows that 30 per cent of the population of South America and 25 per cent of the population of Central America and Caribbean live in the drylands (Reynolds et al. 2007). In Mexico, 30 per cent of the population and almost half the agricultural land of the country are in the drylands (SEMARNAT 2014). In Peru, arid, semi-arid and dry sub-humid areas receive only 2 per cent of total rainfall precipitation of the country. The dry areas of Peru are home to more than 80 per cent of the total population (Ministerio del Ambiente de Perú 2011).

The population of drylands is usually poorer than of other regions and lives under the increasing insecurity threat as a result of climate variability, land degradation

Table 5: Distribution of drylands and human population.

Regions	Distribution of human populations (%)			% of population living in the drylands	% of continental land area
	Arid	Semi-arid	Dry sub-humid		
Asia	5	18	19	42	39.3
Africa	6	18	17	41	43.4
Europe	0	5	20	25	31.5
South America	2	16	12	30	29.2
North America	2	16	5	23	33.4
Central America and the Caribbean	6	11	8	25	n/a
Oceania	1	5	19	25	25
World totals	4	4	17	37	39.7% of globe

Source: Reynolds et al. 2007

and desertification (FAO 2008). According to Quijandria et al. (2001), the areas of LAC most extensively inhabited by the rural poor are arid and semiarid subtropical regions, which include northeastern Brazil, northern Mexico, northeastern Venezuela, the Pacific coastal and central areas of Honduras and Nicaragua, and northern Chile and most of coastal Peru.

In Brazil, the HDI (Human Development Index) for the municipalities in the Area Susceptible to Desertification - ASD[2] based on the education, longevity and income dimensions) is much lower than the country's average of 0.727. The per capita income of the ASD is also the lowest in the country (CGEE 2016). In Colombia, subsistence agriculture, pastoral farming and trade are the main economic activity in the drylands. The rural areas of drylands are inhabited mainly by peasants, "colonos" (settlers) and indigenous peoples. Land degradation and extreme poverty is common in the area (Republica de Colombia 2004). In the Dry Corridor of Central America, more than one million families rely on subsistence agriculture. Poverty and malnutrition affect the population – in particular, rural and indigenous communities (FAO 2015).

Poverty, high dependency on rain-fed agriculture and other stressors make drylands particularly vulnerable to the effects of recurrent droughts, as described below.

Impacts of drought in LAC

Droughts have affected areas of many LAC countries throughout the years – in particular the drylands – including North America (Mexico), Central America, The Caribbean, and South America. The lasting impacts of drought have deeply harmed the economies, people and the environment, causing substantial agricultural losses, advancement of pests and diseases, human migration and poverty increase.

The effects of drought all over LAC are described in the proceedings of the LAC UNW-DPC workshop on capacity building, prepared by Tsegai and Ardakanian (2014). While drought has a negative effect on the entire economy, the agriculture and water supply sectors are usually the most affected, with smallholder farmers who rely on rain-fed agriculture and vulnerable groups such as women and children suffering the biggest losses (FAO 2016, Government of Peru, 2016, CGEE 2016).

According to the LAC proceedings, in Argentina, drought affects all of the country's provinces and related losses are estimated to be 1.1 per cent of the Gross Geographic Product. In Brazil, as a result of the 2012–2013 drought in the Northeast, almost all rain-fed agriculture was destroyed and cattle died, was transferred, or sold at a lower price. In Chile, the 2007–2008 droughts affected a large part of the country from the Atacama region to the Lakes District. Rainfall in the country in 2007 was 48.6 per cent below average and, in Atacama, it was 90 per cent below average. In Costa Rica, in the region of Chorotega, recent droughts have caused agricultural losses of USD 6 million. In Cuba, the droughts of 2004 and 2005 caused damage resulting in losses of USD 37 million. In Honduras, 137 municipalities of the country (46 per cent of the total) have been classified as vulnerable to drought under the National Action Plan for Desertification and Drought Control of 2005. In Mexico, in 2011, 2.7 million hectares of agricultural land were affected by one of the worst droughts of the past six decades, with the states of Sinaloa, Zacatecas and Guanajuato suffering the biggest losses. The 2010 drought in Peru affected more than 66 thousand families and over 330 thousand hectares (Tsegai and Ardakanian 2014).

The "Drought characteristics and management in the Caribbean" (2016) report prepared by FAO, states that

Table 6: Countries that declared state of emergency in 2016 – 2017.

Country	Date	Level	Number of municipalities/ departments/regions
Bolivia	July 2016	Sub-national	104 municipalities
Bolivia	November 2016	National	
Brazil	2016 (as of 18 July 2017)	Sub-national	1450 municipalities
Brazil	2017	Sub-national	1025 municipalities
Colombia	2016	Sub-national	>120 municipalities
Peru	2016	Sub-national	18 out of 25 regions
Chile	2015	Sub-national	194 communities
Cuba	2017	Sub-national	141 municipalities

Source: Brazil (SEDEC/MI - http://www.mi.gov.br/defesacivil), Peru (http://www.eluniverso.com/noticias/2016/12/07/nota/5943064/mas-mitad-peru-emergencia-fuerte-sequia). Bolivia (Reliefweb 2016 and 2017, OCH 2016). Cuba: UNCCD 2017); Chile: Ministerio de Agricultura.

[2] In Brazil, the Area Susceptible to Desertification includes the semi-arid region and surrounding areas.

droughts in the Caribbean have caused significant losses in such vulnerable sectors as the agro-livestock sector industry, bringing losses to poor small rain-fed farmers and threatening livelihoods. During the 2009–2010 drought, one of the worst ever experienced, impacts ranged from severe water deficits to large losses in the agriculture and livestock sectors and increases in food prices and bush fires (FAO 2016). In Guyana, for instance, some rice farmers had to pump saline water for the rice fields. In Dominica, in 2010, banana production declined by 43 per cent compared to the previous year, while in Antigua and Barbuda, onion crop and tomato crop were reduced by 25 per cent and 30 per cent, respectively. In St. Vincent and Grenadines, agricultural production was 20 per cent lower than average and in Trinidad and Tobago the cattle suffered by diseases caused by the lack of water for sanitation (FAO 2016).

The UN Office for the Coordination of Humanitarian Affairs (OCHA) manages a web portal called Reliefweb that provides information on drought, its causes and impacts on countries. Reliefweb reports that the El Nino of 2015–2016 had a devastating effect on the region with several countries declaring a state of emergency (Table 6). In Bolivia, by July 2016, a state of emergency had been declared in 104 drought-affected municipalities with 160 000 people affected (Reliefweb 2017). According to the Government of Bolivia, 740 000 people were affected from December 2015 to September 2016 with eight out of the nine departments in the country suffering from drought (OCHA 2016). The disaster, considered one of the worst in the last hundred years, caused widespread water shortages, resulting in a national state of emergency in November 2016 (Reliefweb 2016). Drought has prompted many protests in major cities and conflicts between miners and farmers over the use of aquifers.

In Brazil, the Northeast experienced the worst multi-year drought in the last hundred years. The drought that lasted 5 years (2012– 2016) affected 23 million people in the semi-arid region (Globo 2017). In 2017, droughts are still ongoing in parts of the region.[3] Only in the State of Bahia, over 300 municipalities declared state of emergency due to lack of rain (Agencia Brasil 2017). In Colombia, in 2016, a public emergency was declared in the Departments of Córdoba and Cesar (Reliefweb 2016a). More than 120 municipalities of the country were suffering from water shortages (El País 2016). In Peru, in 2016, several provinces declared state of emergency and in Ecuador, drought and other disasters brought significant losses to the agricultural sector (Reliefweb 2017). In 2016, after three consecutive drought years, hydropower capacity in Venezuela significantly decreased, which led to a reduction of the work week down to two days, closed schools on Friday and curtailed power supply to manufacturers (Hambling 2016, Schneider 2016). In Paraguay, in 2016 and 2017, the authorities delivered water to thousands of people, including vulnerable indigenous families affected by droughts (Reliefweb 2017).

In the dry corridor of Central America, the 2014–2017 drought was the most severe one in decades, with Guatemala, Honduras and El Salvador among the most affected countries. As of April, 2016, in Guatemala, 1.5 million day laborers and subsistence farmers were affected; in El Salvador, 700,000 subsistence farmers were affected, and 1.3 million in Honduras (OCHA 2016a). To a lesser extent, Nicaragua, Costa Rica and Panama were also hit by disaster. The international community was urged to provide support to the countries facing the impacts of El Nino.

In the Caribbean, the 2015–2017 also saw one of the worst droughts in the last two decades (Reliefweb, 2017a). In Haiti, one million people were affected by drought, especially in the Southeast, Northwest and Artibonite regions. The effects of drought and other natural disasters have increased vulnerability of the population already facing food insecurity. International aid has played a significant part of the response strategies of the country. In Cuba, in 2015, water crisis affected 144 municipalities and about 100,000 people relied on water delivered by tanks (Reliefweb, 2017a). The March 2017 update of UNCCD reports that Cuba is experiencing one of its worst droughts in a hundred years, with 80 per cent of the population affected. The shortages caused by the lack of rain are compounded by an aging and dilapidated infrastructure. More than 50 per cent of the available water is lost due to leaks in the drainage system. Out of 168 municipalities, 141 are affected and 53 have declared a state of extreme drought (UNCCD 2017).

The droughts described above have caused immeasurable losses of crops and livestock, brought down water levels in dams, brought pests and diseases, threatened energy security, increased forest fires, caused severe water shortages, increased migration and created food insecurity in the affected areas. In particular, droughts have increased the pressure on women, who are traditionally responsible for fetching water and are often left behind in the drought-affected areas with children while men migrate in search of work.

Impacts of drought may multiply in a changing climate. According to the World Bank (Verner, 2010), reductions in rainfall could create severe water shortages in arid and semi-arid regions of Argentina, northeast Brazil, Chile, and northern Mexico, as well as in the northern Amazon. Verner (2010) also calls attention to the possibility that disruptions in the moisture process in the Amazon could trigger desertification over vast areas of LAC. Water scarcity In LAC could become more severe as a result of extreme drought events brought on by climate change.

[3] In fact, at the time this paper was written (July 2017), there was still an ongoing drought in parts of Northeast, such as the Semi-arid of Bahia and Pernambuco. In the North of the Northeast (states of Piauí, Ceará, Rio Grande do Norte and Paraíba and part of Pernambuco), the amount of rain was about average for a normal rainy season from January to May, but very little water accumulated in reservoirs. The 2010 was also a drought year, so between 2010– 2016, six out of seven were drought years.

Response to drought in LAC

To date, many countries in the region and across the world have traditionally adopted a reactive approach to drought management by providing food, water, medical assistance, cash for work and feed for farm animals to affected populations as a temporary measure. To improve effectiveness of relief actions, countries in the region such as Argentina, Brazil, Chile, Mexico and Peru, among others, have established a consolidated national civil defense system responsible for providing relief in case of natural disasters (including drought) and improving coordination of relief efforts at national, state and local levels (see Box 4 for the Civil Defense System in Brazil). However, recent droughts, particularly, in Central America and the Caribbean, have shown that many countries do not have the capacity and financial means to cope with drought and require support from regional and international organizations.

Drought response needs to advance to a new level in many LAC countries. A reactive approach does not develop the resilience of people and economy to a future drought.[4] Proactive planning and mitigation measures work to decrease vulnerability to drought, especially in arid and semi-arid zones, and reduce socio-economic, environmental and health impacts of extreme events. Though crisis management has been the most common way to cope with drought in LAC countries, there have been ongoing efforts to shift drought policies to a proactive risk management approach.

Drought monitoring and early warning systems have been implemented as a critical pillar of drought risk management strategies in such countries as described by Tsegai and Ardakanian (2014). In Chile, the National System for Agricultural Emergencies and Agro Climatic Risk Management has been established under the Ministry of Agriculture. Among other actions, the system provides information on current and past conditions, climate forecasts and warnings, possible agricultural impacts and recommendations on production. Cuba has an Integrated Drought Monitoring and Early Warning System, while drought-monitoring networks have been implemented in Jamaica and Nicaragua. In Peru, a national drought observatory is under development to produce maps and figures for historical and current droughts and projections (Tsegai and Ardakanian, 2014). Peru also released the Multisectoral Prevention and Risk Reduction Plan for 2016 (Reliefweb 2017).

Since 2013, Mexico has a national drought monitoring and early warning system (see Box 5). The country has launched one of the first national drought policies in the world, the National Program against the Drought (PRONACOSE).

BOX 4.

THE CIVIL DEFENSE SYSTEM IN BRAZIL

In 2012, the law on the National Policy for Civil Defense and Protection (PNPDEC) was issued to implement disaster risk management in Brazil and to create the National System for Civil Defense and Protection (SINPDEC) and the National Council on Civil Defense and Protection (CONPDEC). SINPDEC is aligned with UNISDR and deals with all types of disasters, including floods and droughts.

SINPDEC brings together national, state and municipality institutions, both public and private, to implement PNPDEC. Under SINDPDEC, the National Secretariat of Civil Defense and Protection (SEDEC) of the Ministry of National Integration is responsible for coordinating civil defense actions all over the country. After recognizing a state of emergency in states or municipalities, SEDEC provides federal funding for relief actions. All the states of Brazil have an entity responsible for the development of civil defense and protection actions and most municipalities have a local body for civil defense and protection (COMPDEC).

Also under the SINDPEC, the National Center for Risk Management and Disasters (CENAD) is responsible for consolidating information on disaster risk in the country to support preparedness actions on vulnerable communities. The National Center for Monitoring and Early Warning of Natural Disasters (CEMADEN) monitors the municipalities that have a history of natural disasters.

Declaring a state of emergency

The Municipality or the States can declare a state of emergency (SE) or state of public calamity (ECP) to request assistance and humanitarian help for the populations affected by disasters. If more than one municipality is affected by the same disaster, the State Governor can declare state of emergency in the affected municipalities. There are three levels of disasters: I, II and III, according to their intensity. The first two levels require a state of emergency while the third level means a state of public calamity.

Through the Integrated Information System on Disasters (S2ID), the decree and supporting documents are sent to SEDEC of the Ministry of National Integration to start the process for the allocation of federal funds.

[4] That is not to say, however, that reactive policies necessarily mean relief policies. There are cases when the reaction triggers a policy that is aimed at reducing future vulnerability – for example, building of reservoirs to increase resilience to drought.

Regionally, efforts on drought monitoring and early warning systems have been developed in Central America (SATCA platform and UN-SPIDER SEWS), in North America (North American Drought Monitor) and Latin America and the Caribbean as a whole (The Latin American and Caribbean Flood and Drought Monitor).

As mentioned above, consolidated risk management and mitigation actions are still not included in the drought policies of most countries. Drought experts in the region have indicated several challenges and constraints to developing a proactive risk management approach in the region including: weak institutional frameworks and coordination, lack of capacity building/training, weak monitoring networks, absence consolidated information system and lack of financial resources. A comprehensive national drought policy should aim to address these challenges.

How to reduce the impacts of drought

The objective of a proactive drought policy is to reduce the risk of drought impacts in the future, while providing relief assistance to people impacted by drought. Ideally, the assistance provided during drought should be consistent with long- term policies that work to reduce drought vulnerability.

The components and conditions of a proactive drought policy that can be implemented in LAC countries are presented in Sections 1 through 5 of this paper.

BOX 5.

NATIONAL DROUGHT POLICY IN MEXICO

Throughout the years droughts of different intensities in Mexico have affected the entire country. The mean annual precipitation in Mexico is 760 mm, but most of the north and central regions have a, mean annual precipitation of 500 mm. In five northern and central states – Aguascalientes, Baja California, Baja California Sur, Coahuila and Sonora – about 90 per cent of the territory is very dry, dry or semi-arid according to the Koppen-García climate classification system (Aguilar-Barajas et al. 2016).

The 2010–2013 droughts affected 90 per cent of the Mexican territory and in particular, the Northern States. After this severe multi-year drought, there was an increased support for adopting a more of a preventive and proactive perspective. In 2013, Mexico launched one of the first national drought policies in the world, the National Program Against the Drought (PRONACOSE) with the National Water Commission (Conagua) as the body responsible for coordination.

Pronacose's goal is to develop the Drought Prevention and Mitigation Programs (PMPMS) and address drought events at the watershed level while developing institutional local capacity along with coordination and implementation of mitigation activities (Arreguin-Cortés et al. 2015; Arreguín-Cortés et al, 2016a, b).

The program has six implementation phases:

First phase. First version of the 26 basins' PMPMS completed, the Inter-Ministerial Commission is in full operation, and basic training and agreements with watershed council members are concluded.

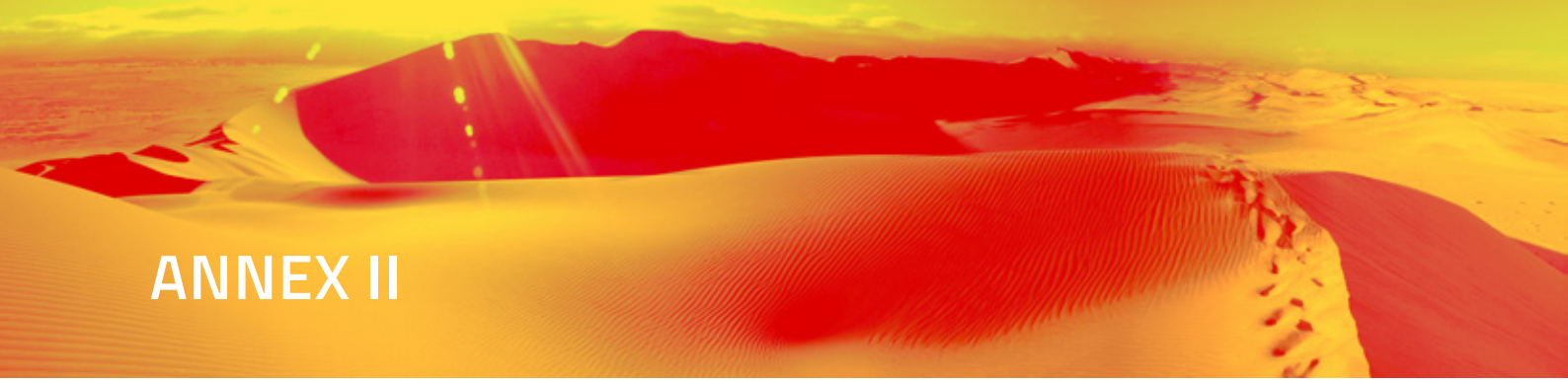
Second Phase. Elaboration of the first PMPMS for two cities on each basin, the research agenda definition and development of vulnerability evaluation criteria. A media campaign to present and publicize information about the PMPMS. Interaction with the National Civil Protection System (SNPC) to implement early warning protocols for the different basins.

Third and Fourth Phases. Evaluate and update the PMPMS's and develop PMPMS´s at the water utilities level. In coordination with the SNPC, integrate the risk atlas with drought information on vulnerabilities and protocols.

Fifth and Sixth Phases. Evaluate the NDP, the implementation of revised PMPM's and institutional adjustment of federal, state and municipal governments' programs to be aligned with the new policy.

Pronacose has succeeded in implementing a national drought monitoring and early warning system (Aguilar-Barajas et al. 2016). The Mexican Drought Monitor, which is part of the North American Drought Monitor, is updated every 15 days by the National Meteorological Service (SMN). Figures are published for watersheds, states and municipalities.[5] The degree of drought intensity is based on the U.S. Drought Monitor. SPIs and SDIs are determined on a weekly basis for main weather points and stations (Arreguin-Cortés et al. 2015, 2016a,b).

[5] http://www.gob.mx/conagua/acciones-y-programas/programa-nacional-contra-la-sequia-monitoreo-de-la-sequia-64594.



ANNEX II

DISASTER RISK MANAGEMENT: CONCEPT AND INTERNATIONAL FRAMEWORKS

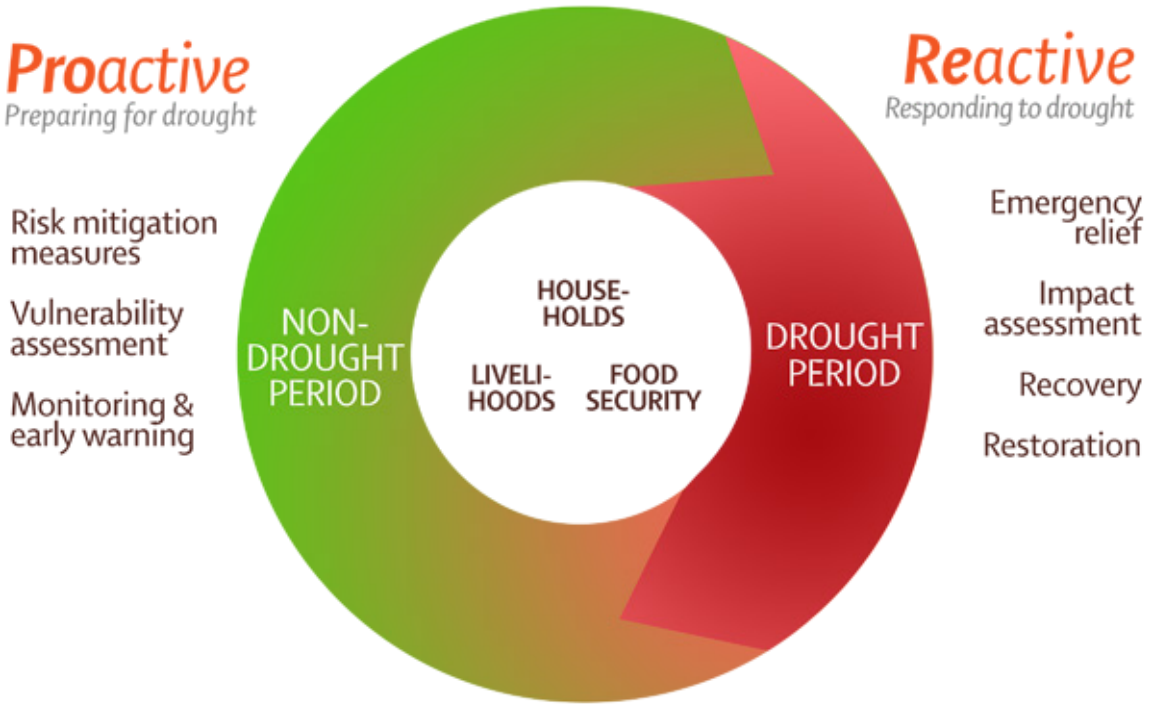
Disaster management cycle

Drought risk management involves actions that aim to reduce the risk of future drought by reducing vulnerability and increasing resilience. Brüntrup and Tsegai (2017) modify the cycle of Disaster Risk Management, presented initially by Wilhite et al (2014) and Wilhite (2006) (see Figure 1). It refers to all kinds of natural disasters, including drought. The cycle is divided into two phases: the "protection" phase (proactive), which includes mitigation, preparedness, prediction and early warning; and the "recovery" phase (reactive), which includes impact assessment, response, recovery and reconstruction. In the case of drought, there is less need for reconstruction than in the case of floods and other natural hazards. While the protection phase is associated with risk management, the recovery phase is associated with crisis management. In general, government policies have been leaning towards the crisis management approach, trying to cope with the drought situation when the disaster occurs, rather than with to manage risks, reduce vulnerability and increase drought resilience.

Researchers argue that if more emphasis is placed on the risk reduction part of the cycle, there will be less need for emergency relief measures since impacts of disasters will be reduced.

The World Meteorological Organization (WMO), the FAO, the UNCCD, the National Drought Mitigation Center (NDMC) of the University of Nebraska, the

Figure 1: The cycle of disaster risk management.



Source: Brüntrup and Tsegai (2017)

Convention on Biological Diversity CBD), the Global Water Partnership and the UN-Water Decade Programme on Capacity Development (UNW-DPC) are among the institutions that have led the discussions on drought and that have urged countries from LAC and other regions to shift to a proactive risk management approach by implementing national drought policies and increasing mitigation measures.

There is a general consensus that countries' vulnerability to droughts could be significantly decreased if national drought policies in drought-prone countries were developed with emphasis on drought monitoring and early warning systems; development of vulnerability and impact assessments; and mitigation and response measures. In other words, if drought policies focused more on the reducing-risk approach than in the crisis-management approaches.

The Hyogo Framework of Action (HFA) (2005-2015)

At the World Conference on Disaster Reduction (WCDR) in January 2005, governments and other actors committed to "the substantial reduction of disaster losses, in the lives and in the social, economic and environmental assets of communities and countries." The result was the adoption of the Hyogo Framework of Action (HFA) 2005-2015: Building the Resilience of Nations and Communities to Disasters." The framework has since served as a key global instrument for reinforcing political awareness and momentum for disaster and risk reduction. It has inspired new policies and strategies, creating created global and regional mechanisms for greater cooperation and collaboration (UNISDR 2006, 5-6).

The Sendai Framework for Disaster Risk Reduction (2015-2030)

On March 18, 2015, the Sendai Framework for Disaster Risk Reduction 2015–2030 was adopted at the Third UN World Conference in Sendai, Japan. The Sendai Framework lays out 13 principles and four priorities for nations to reduce risks from natural disasters. The four priorities for action include: i) understanding disaster risk; ii) strengthening disaster risk governance to manage disaster risk; iii) investing in disaster risk reduction for resilience, and; iv) enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction (UNISDR 2015).

High-level Meeting on National Drought Policy (HMNDP)

Recognizing the importance of national drought policies to help countries shift from a reactive crisis management to pro-active risk management mode, the WMO Congress at its Sixteenth Session (Geneva, 2011) recommended the organization of a "High-level Meeting on National Drought Policy (HMNDP)". Following that recommendation, an organizing committee coordinated by the WMO, FAO and the UNCCD prepared the high level meeting, including a workshop in Washington, DC to develop a compendium on drought policy (Sivakumar et al, 2014), and meetings in Brasilia, Geneva, and Rio de Janeiro, within the context of the Rio + 20 Summit on Environment and Sustainable Development.

The HMNDP was held in Geneva in March 2013, and was jointly organized by the WMO, the UNCCD and the FAO, with input from several partners and with the goal "to provide practical insight into useful, science-based actions to address key drought issues and various strategies to cope with drought" (Sivakumar et al. 2014). The event was attended by 414 delegates who included delegates from 87 countries along with representatives of International and Regional organizations and UN agencies (Sivakumar et al. 2014). The HMNDP generated three main outcomes: a policy document, a science document and a final declaration. These documents are available online (see UNCCD, FAO & WMO. 2013 a, b, c). Information on the HMNDP and its outcomes is available in the webpage of the WMO (www.wmo.int).

HMNDP encouraged all governments to develop and implement national drought management policies (NDMP), consistent with national development laws, conditions, capabilities and objectives. Among main recommendations to guide the development of NDMP, HMNDP emphasized the development of proactive drought impact mitigation, preventive and planning measures, risk management, fostering of science, appropriate technology and innovation, public outreach and resource management. The HMNDP was also important as a starting point for coordinated action of UN and other global and regional institutions on issues related to drought policy and management.

Integrated Drought Management Programme (IDMP)

During the HMNDP, the WMO and the Global Water Partnership (GWP) launched the Integrated Drought Management Programme (IDMP). The IDMP was created to provide policy and management guidance and share scientific information, knowledge and best practices for integrated drought management. The IDMP is guided by an international Management Committee and an Advisory Committee and members are representatives of the WMO, GWP and partners (IDMP 2014). The IDMP Technical Unit is located at the headquarters of the WMO, in Geneva, Switzerland.

Being consistent with the recommendations of the HMNDP, the IDMP developed a help desk that can be accessed by all those interested in developing drought policies or receiving more information on them. The address of the Help Desk is: http://www.droughtmanagement.info/

The ¨ Help Desk contains general information on the IDMP and its objective "to support stakeholders at all levels by providing policy and management guidance and by sharing scientific information, knowledge and best practices for Integrated Drought Management." It also

provides access to key documents of the IDMP such as its concept note and the operational guidelines.

The Help Desk users can also access knowledge resources on integrated drought management, including guidelines and tools and a library with a wide variety of books and publications on the several aspects of drought.

Drought practitioners can also submit their questions to the IDMP Technical Support Unit. WMO, GWP and the IDMP partner organizations, each with diverse expertise in drought management, provide responses to Help Desk inquiries. Government officials, civil society organizations, meteorologists, academics and private sector professionals facing drought-related issues are encouraged to submit their queries through Help Desk, which will forward them to the IDMP partner organization best equipped to provide a tailored response.

Users can also access the information on the IDMP activities and ways to ways join them. In LAC, the IDMP developed regional activities in Central America and national activities in Mexico, where it provided support for the Programa Nacional contra las Sequías (Pronacose).

Under the IDMP, the National Drought Management Policy Guidelines have been published to provide a template for action for countries that wish to develop national drought management policies and drought preparedness/mitigation plans, based on the ten- step planning process. The guidelines can be found on the IDMP website: http://www.droughtmanagement.info/find/guidelines-tools/

UN-Water initiative on Capacity Development to Support National Drought Management Policies (NDMP) and the LAC workshop

The UN-Water initiative on Capacity Development to Support National Drought Management Policies was also launched during the HMNDP to increase capacity of drought-prone countries to formulate and adopt risk-based national drought management policies. The initiative is a collaborative effort of the WMO, FAO, the Convention on Biological Diversity (CBD), UNCCD and the UN-Water Decade Programme on Capacity Development (UNW-DPC) (Tsegai and Ardakanian, 2014).

Regional workshops have taken place in Eastern Europe (July 2013), Latin America and the Caribbean (December 2013), Asia and the Pacific (May 2014), Eastern and Southern Africa (August 2014), Near East and North Africa (November 2014) and West and Central Africa (May 2015) countries. The proceedings of the regional workshops are available on the UN Water website: http://www.ais.unwater.org/ais/course/view.php?id=37

'The Regional workshop on capacity development to Support National Drought Management Policies for Latin America and the Caribbean" took place held from 4-6 December 2013 in Fortaleza, Brazil and attended by drought experts and policy makers from Argentina, Brazil, Chile, Costa Rica, Cuba, Honduras, Jamaica, Mexico, Nicaragua, Panama, Peru and Uruguay and from international organizations such as UNCCD, WMO, FAO and CBD.

.The workshop's thematic presentations were streamlined to follow three areas, or pillars, taking into account that national drought policies needed to be developed considering each country's specificities:

i) Drought monitoring and early warning systems

ii) Vulnerability assessment and impacts

iii) Mitigation and response

During the LAC workshop several cases of droughts impacts and policies in Latin America and Caribbean have been presented and discussed.

UNCCD and the emphasis on drought risk mitigation

The Agenda 21 of the Rio Conference, in 1992, recommended the creation of the United Nations Convention to Combat Desertification (UNCDD). The convention was adopted in 1994 and entered into force in 1996 to address land degradation in arid, semi-arid and dry sub-humid areas (drylands) and promote sustainable land management. UNCCD is the only legally binding international agreement on land issues, promoting sustainable land stewardship. Its 196 Parties work in partnership to fight desertification, restore degraded lands and achieve the Sustainable Development Goals, especially SDG 15 and target 15.3 on land degradation neutrality, so that healthy and productive land can continue to provide humanity with food, water, energy and other ecosystems services essential to sustaining life on Earth.

The three recent Conference of the Parties (COP) of the UNCCD (2013 in Namibia, 2015 in Turkey and 2017 in China) emphasized that proactive mitigation measures are an integral part of effective drought coping strategies. They supported the results of the HMNDP and the search for land degradation neutrality.

COP 11

The eleventh session of the Conference of the Parties (COP 11) to the UNCCD took place in Windhoek, Namibia in September, 2013 under the theme "A stronger UNCCD for a land-degradation neutral world." In the conference's final declaration, , the Government of the Republic of Namibia emphasized the need to address drought mitigation and develop national drought policies as a matter of priority (see Box 6):

COP 12

The twelfth session of the Conference of the Parties took place in Ankara, Turkey in October 2015. The Parties agreed on the SDG target on land degradation neutrality (LDN) with emphasis on actions that promote sustainable land management and rehabilitation of degraded lands. Among other objectives, the Ankara

BOX 6.

DECISION 9/COP.11 – Ways of promoting and strengthening relationships with other relevant conventions and international organizations, institutions and agencies

The Decision 9 of COP 11 held in Namibia in 2013 recognizes the following outcomes of the HMNDP:

(a) Drought has major implications in terms of social, economic and environmental impacts;

(b) There are insufficient policies for appropriate drought management and proactive drought preparedness in many countries around the world;

(c) Most countries continue to respond to drought in a reactive, crisis management mode.

Following up the HMNDP outcomes, COP 11:

- Urges Parties to develop and implement national drought management policies, consistent with their national development priorities, objectives and policies that address the social, economic and environmental impacts of drought;
- Requests the secretariat, making use of the advocacy policy framework on drought, including water scarcity, as contained in document ICCD/CRIC(11)/17, to assist country Parties, as appropriate, to promote and strengthen partnerships to develop and implement national drought management policies;
- Invites the World Meteorological Organization, the Food and Agriculture Organization of the United Nations, other United Nations agencies, programmes and treaties, as well as other concerned parties, to collaborate with the UNCCD towards assisting country Parties, especially the developing countries, in elaborating national drought management policies and their implementation;
- Also invites the World Meteorological Organization, the Food and Agriculture Organization of the United Nations and the UN-Water Decade Programme on Capacity Development to continue collaborating with the UNCCD in undertaking capacity building initiatives towards assisting countries to develop and implement comprehensive national drought management policies in accordance with the principles and provisions of the UNCCD, and in line with the advocacy policy framework on drought, including water scarcity;

For the full document of Decision 9, see http://www2.unccd.int/sites/default/files/inline-files/dec%209-COP11.pdf

initiative was launched to achieve LDN, emphasizing that the combination of early warning and land use planning can help to achieve this goal and to mitigate drought effects (UNCCD 2015).

Overall, the UNCCD, following the recommendations of the HMNDP, supports the development of national drought policies based on the principle of risk reduction by strengthening three pillars: drought monitoring and early warning systems; vulnerability and risk assessment; and drought risk mitigation and measures. Coordination at country and regional levels is essential for the development of proactive measures to combat drought and desertification (UNCCD 2014, UNCCD 2016).

Africa Drought Conference

The first African Drought Conference, held in Windhoek, Namibia in August 2016, brought together African Member States and parties to the United Nations Convention to Combat Desertification (UNCCD), ministers, heads of delegations and experts to discuss ways to enhance drought resilience in Africa. Two major outcomes of the Conference are the Windhoek Declaration and the White Paper on Drought Resilient and Prepared Africa (DRAPA). Signatories to the Windhoek Declaration committed to the implementation at national level of a strategic framework for DRAPA, guided by 6 principles: (i) Drought policy and governance for drought risk management; (ii) Drought monitoring and early warning; (iii) Drought vulnerability and impact assessment; (iv) Drought mitigation, preparedness, and response; (v) Knowledge management and drought awareness; and (vi) Reducing underlying factors of drought risk.

Latin America and Caribbean Drought Policy Conference

The LAC Regional Drought Policy Conference was held in Santa Cruz de la Sierra, Bolivia, from 14 to 16 August, 2017. It was organized and promoted by the UNCCD, FAO and the Government of Bolivia. Participants included national focal points from LAC, including the Minister of Environment of Bolivia, and the representatives of the UNCCD, FAO, WMO and the World Bank. Participants discussed a draft of this

white paper "Towards National Drought Policies in LAC";aimed at fostering drought policies in the region and approved the Declaration of Santa Cruz, which invites all participants to work with their governments to develop integrated national drought policies.

Santa Cruz de la Sierra Drought Conference Declaration

Recognizing that drought is an important issue for the region of Latin America and the Caribbean (LAC) and that the lack of integrated management has deeply harmed the agricultural, water, urban, economics, and environmental sectors and the people of countries in the region;

Noting that vulnerability to drought is different in magnitude in the countries in the region including Small Island States, Developing Countries and Developed Countries;

Reaffirming that the challenges posed by drought, desertification and land degradation on economic and social development, food security and poverty eradication require concerted action to address them;

Acknowledging that drought resilience is imperative to achieving the Sustainable Development Goals, including the target 15.3, which incorporates Land Degradation Neutrality (LDN);

Underscoring the disastrous impacts of the 2016 drought episode in the region as one of the most severe in recent times;

Having met in Santa Cruz de la Sierra, Bolivia from 14 to 16 August 2017;

We, the conference participants,

Agree to work to include integrated drought management in the development and implementation of National Policies and Plans.

Agree to take into consideration the following three pillars on Integrated Drought Management and in the process of developing National Policies and Plans;

- *Drought Monitoring and Early Warning*
- *Vulnerability and Impact Assessments*
- *Mitigation and Preparedness*

Further agree to provide additional input to the Draft White Paper on "Towards National Drought Policies in LAC";

Reaffirm our commitment and urge others in the region to use the 10-step process in the "Drought Guidelines as a template for action" with the full consideration that these guidelines should be modified to fit the situation in the different countries in the region;

Request the United Nations Convention to Combat Desertification (UNCCD), the Food and Agriculture Organization of the United Nations (FAO), the World Meteorological Organization (WMO), and other related United Nations agencies, programmes and initiatives, to assist governments in the region, in a coordinated manner, in the development of their national drought monitoring, early warning systems, vulnerability studies, impact assessments, mitigation and preparedness policies and plans.

COP 13

The emphasis on drought and drought policies achieved during COP11 and COP12 have been confirmed and expanded at the COP 13, held in Ordos, China, on 6–16 September 2017. COP13 also considered the results of the discussions of the Bolivia Drought Policy Conference that took place in August 2017, in Bolivia, including the Santa Cruz Declaration.

COP13 approved a new policy advocacy on drought, inviting countries to "Pursue a proactive approach on integrated drought management in the process of developing national drought policies based on the three key pillars of national drought policy:

(i) implementing comprehensive drought monitoring and early warning systems

(ii) completing vulnerability and impact assessments for sectors, populations and regions vulnerable to drought; and

(iii) implementing drought preparedness and risk mitigation measures" (UNCCD, 2017[a])

The UNFCCC and the Paris Agreement

The United Nations Framework Convention on Climate Change (UNFCCC) was signed during the Rio Summit in 1992 and, together with the Convention on Biological Diversity (CBD) and the UNCCD, is considered as one of the Rio Conventions. There is a close link between the UNCCD, which deals with desertification and drought, and the UNFCCC, which focuses on climate change. According to the scenarios proposed by the UNFCCC and the IPCC, that as more vulnerable regions, drylands will experience more severe negative impacts of climate change in the future.

The problems of desertification and drought that we face today may become more serious in the future, as climate change will increase weather variability. Droughts, floods and higher temperatures tend to increase humanitarian challenges throughout the world and require scaling up the efforts that promote adaptation and build resilience of people and ecosystems.

The University of Nebraska-Lincoln and the National Drought Mitigation Center (NDMC)

The National Drought Mitigation Center was established in 1995 at the University of Nebraska-Lincoln under the leadership of Dr. Donald A. Wilhite to help with the development and implementation of measures to reduce societal vulnerability to drought, emphasizing preparedness and risk management rather than crisis management. In the United States, the NDMC works with state governments and indigenous groups to develop drought risk management strategies. It also assists national governments around the world.

The NDMC is home to the U.S. Drought Monitor (USDM), a map published weekly to give information of droughts in the country, based on climatic, hydrologic and soil conditions and local observers' reports.

The map is produced through a partnership between the NDMC, the United States Department of Agriculture (USDA), the National Oceanic and Atmospheric Administration (NOAA) and experts around the United States. The USDM has been used by the media, policy makers and drought response agencies in the USA. The USDA uses the USDM, for instance, to assess disaster declarations and eligibility for low-interest loans (USDM 2014). More information on the NDMC's project can be found by following this link: http://drought.unl.edu/Portals/0/docs/factsheets/overview2.pdf

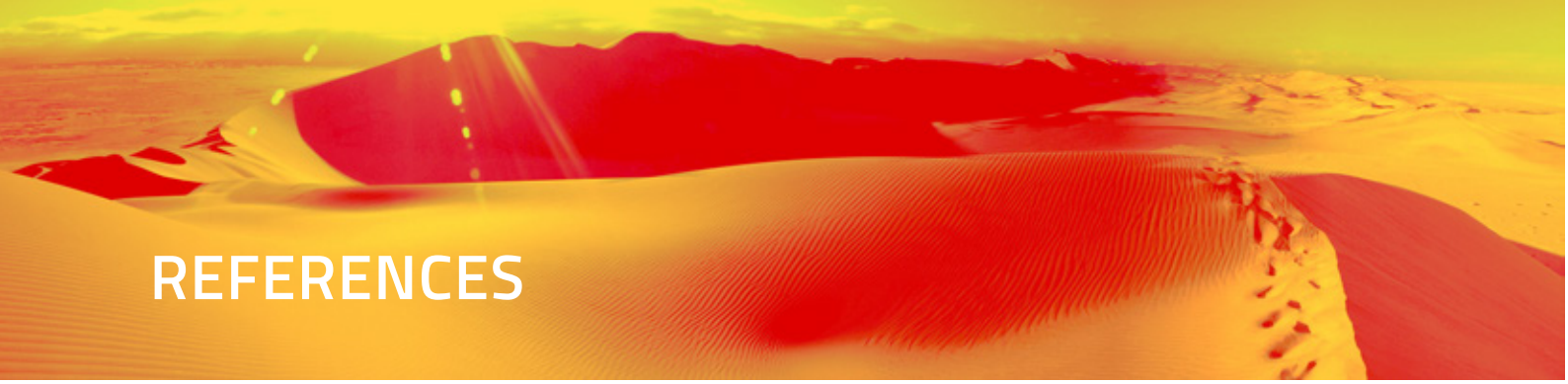
Global framework on water scarcity in agriculture (WASAG)

The Global Framework for Water Scarcity in Agriculture under a changing climate (WASAG) is a FAO-led global initiative to foster collaboration among partners for the development and implementation of policies and programmes for the sustainable use of water in agricultural sectors, using context-specific approaches and processes. WASAG seeks to identify priority actions for the adaptation of agriculture to climate change and for scaling up of successful responses to the threats to agricultural production posed by increasing water scarcity.

WASAG was officially launched during the COP 22 of the UNFCCC in Marrakesh, Morocco in November 2016, calling for concerted efforts among role players to respond to the challenges posed by water scarcity in agriculture, exacerbated by climate change and a growing world population.

In August 2017, the Interim Steering Committee of WASAG agreed, in the margins of the Stockholm World Water Week, to establish a working group that will focus on drought preparedness. The working group focuses on identifying practical solutions to deal with droughts and their impact on agriculture, livestock, food and nutrition security.

More information can be found at: http://www.fao.org/land-water/overview/global-framework/global-framework/en



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TOWARDS NATIONAL DROUGHT POLICIES IN LATIN AMERICA AND THE CARIBBEAN REGION

WHITE PAPER

WORLD METEOROLOGICAL ORGANIZATION

Food and Agriculture Organization of the United Nations

MINISTERIO DE MEDIO AMBIENTE Y AGUA

United Nations Convention to Combat Desertification