

# National Drought Policy in Mexico, a paradigm change: from reaction to prevention

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## Resumo

O México está sujeito à ocorrência de secas e tem sofrido vários impactos desse fenômeno ao longo da história. A seca de 2010-2012, que afetou a maior parte do país, desafiou o enfoque reativo de abordagem desse fenômeno natural e cristalizou a construção de um enfoque preventivo. Mudar o paradigma de como lidar com secas cíclicas usando o Programa Nacional contra Secas (Pronacose) como estratégia de implementação, juntamente com um conjunto de princípios gerais e instituições de coordenação administrativa, provê uma nova experiência de governo que pode ser considerada em diferentes esforços globais para abordar as secas. Tendo em vista que algumas experiências internacionais de políticas de secas foram consideradas enquanto

## Abstract

*Mexico is prone to drought occurrences and has suffered several impacts from cyclical appearances of these climatic events through history, the 2010-2012 drought that affected most of the country challenged the reactive approach addressing the natural phenomena and catalyzed the construction of a preventive approach. Changing the paradigm on how to tackle cyclical droughts using the National Program against Drought (Pronacose) as the implementation strategy, together with a set of general principles and administrative coordination institutions provides a novel governmental experience that can be considered for different global efforts to address drought. Since some international experiences on drought policies were*

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o Programa Nacional de Secas do México estava sendo desenvolvido, isso também representou uma experiência dinâmica que poderia ser utilizada para validar algumas das recomendações correntes dos especialistas sobre o assunto.

**Palavras-chave:** Seca de 2010-2012. Planejamento de secas no México. Pronacose. Políticas de secas.

*considered while the Mexican National Drought Policy was developed, it also represents a dynamic experience that might be used to validate some of the current experts' recommendation on the issue.*

**Keywords:** 2010-2012 drought. Drought planning in Mexico. Pronacose. Drought policies.

## 1. Introduction

The persistent drought that most of the Mexican territory experienced during the last months of 2010 extending until 2013 exposed the limitations of dealing with the phenomena using a reactive approach, even though some early warning signs were provided through the drought monitor, and unprecedented coordination of governmental efforts were made to help the affected communities, together with state and local authorities, still most of the infrastructure investments were not in place fast enough to help with the emergency, although mitigation programs that included temporary jobs, water and food for poor communities, and insurance coverage for agricultural and farm losses were able to help.

Droughts have significant impact in almost any social activity, depending upon the vulnerability of a region, a community or a country. Agriculture is the first economic sector affected by lack of water and areas without irrigation infrastructure suffer the most, considering that even under normal conditions those areas do not have a reliable source of water to plan on agricultural activities, and some of people's activities are for subsistence not for commercial production, peasants are left stranded with no chance of sustenance forcing migration.

Another aspect is the health impact on children and older people whom are more vulnerable because of lack of water in quantity and quality, in certain urban areas with deficit on potable water the drought exacerbates the unhealthy living conditions that in some cases may turn deadly, therefore, health issues and living conditions are affected also by less available water.

The environment is also deeply affected by lack of water, since every ecosystem needs water for sustainability, forestry is affected not only because of dry conditions but also because drought augment the risk of fires and plague which end up affecting all kind of animals and plants that live in the forest or get some benefit from its conditions.

Social and political unrest might arise once drought effects are felt by different sectors of the community, and since reactive approaches seldom help to solve the water crisis, a vicious circle of anger, opposition and unrest makes even harder collaboration strategies to make the most out of the water available for the different sectors in a community.

Tourism and other economic activities also are affected by lack of water or low levels on lakes, dams and rivers, as well as other recreational activities that demand large quantities of water.

### 1.1. Drought in Mexican history

Mexico shares the same arid conditions that the world's largest deserts, the 20° to 35° North latitude range should have been a desert if not by the water available from the hurricane and monsoon seasons, and also with help from the particular geography of the Tehuantepec Isthmus that allows a closer humid interaction between the Gulf of Mexico and the Atlantic ocean on the southern part of the country. Nevertheless, the arid and semi-arid territory has suffered from cyclical droughts that can be traced using different methodologies from pre-Hispanic times even in the tropical areas of Mexico, where most of the native cultures developed.

Drought is considered among the most current explanations for the demise and fall of the ancient Toltec, Mayan and Tehotihuacan cultures (KENNETT, 2012; Desastres y Sociedad, 1993; GILL, 2008). Even though systematic and extensive data on droughts for the region is not available for the prehispanic period (1500 B.C.-1521 A.D.), the impacts are somewhat documented and expressed in ancient codes. Once the central and northern territories of Mexico were slowly inhabited by Spaniards moving north during the age of the New Spain, better records were made and drought events and its effects were documented on these thirsty regions of the country.

From the colonial period (1521-1821) are of particular importance the droughts on 1785-1786 because their extent over most of the populated territory of the New Spain, and also because their economic effects lasted more than two decades after the episode, linking their effects with another drought episode in the early nineteen century (1808-1810) (SARH, 1980), these two droughts had a devastating effect particularly on agriculture on the Bajío region, where the Independence movement sparked. Some historians note that the bad economic conditions associated with the drought had a catalytic effect on the civil uprising (TUTINO, 1990; BRADING, 2008).

After Mexico's independence from Spain a litter of regional conflicts, civil rebellions and disputes made that record keeping of data was scattered and random, however some information exists from that period, which documents the effects that at least 10 droughts had through

different regions in Mexico from 1821 to 1875; after the civil war ended some stability during the Porfirian era took over (1876-1911) and governmental registry of information was enhanced, the foundation of the Central Meteorological Observatory in 1877 (the founding institution that later became the National Meteorological Service) helped to have a systematic meteorological data logging (CONAGUA, 2012).

From this latter period, the economic impacts on agriculture and farming were made evident with regional records of food and water deficit, cattle deaths and famine, migration and social conflict, 29 drought episodes are noted over Mexico, the impacts on the northern lands prompted users to request the government to build different types of irrigation and water storage infrastructure in Sinaloa, Sonora, Baja California and along the Rio Bravo. From this period we can find records of the first mitigation measures like moving cattle herds to non-drought affected regions avoiding massive deaths (CONTRERAS, 2005).

During the twentieth century a more detailed record of droughts and their effects was available in Mexico. Some of those droughts were part of events that affected several regions in the world, such was the case in 1951 when Europe, Asia and Oceania were affected; 1956 also with effects in Europe, Asia and America; and in 1972 with significant impacts in Oceania, Asia and America; out of 38 droughts recorded in Mexico from 1911 to 1977, 17 can be linked to world events.

At least 20 out of the total episodes qualified as severe droughts affecting economic production and people livelihood, but during 1925, 1935, 1957, 1960, 1962, 1969 y 1977 they were considered extremely severe, in particular the 1960, 1962, and 1969 that created a crisis in agriculture that spilled over the rest of the Mexican economy and society (CASTORENA, 1980).

The 1956-1957 drought that affected mainly the northern border states of Tamaulipas, Chihuahua, Coahuila, Sonora and extended to Sinaloa, Durango, Zacatecas, Colima, Aguascalientes and even the southern state of Oaxaca had significant social effects causing unemployment and migration (CERANO *et al.*, 2011). The government reacted with some infrastructure works, but evidently it was not enough to deter migration.

In 1969 the drought impacted 20 percent of the non-irrigated land, forcing the government to create a "Plan to fight drought" which included temporary jobs for farmers and instructions for insurance coverage on unpaid bank loans. Every event was treated as a disaster that had to be attended by the government, reacting to minimize the impact of the phenomena. Infrastructure works were made after the fact, in some way generating some marginal economic activity in the affected zone. During this period the environmental concerns and impacts were not considered as part of the governmental strategies to minimize drought effects.

During the last decade of the twentieth century extreme droughts were experienced by Chihuahua and Sonora, even though their effects were devastating in those states and their vicinity, it didn't affect the rest of the country (NÚÑEZ, 2007), some irrigation districts suffered because the water stored in dams were used during the drought period until they were almost empty by 1994, it was clear that preventive drought management protocols were not in place at the time (MUSSALI and IBÁÑEZ, 2012).

Several observations can be made out of this brief recount of drought events in Mexico: First is the lack of data for the whole of the territory since vast areas were inhabited until the colonial period when the north slowly began to grow in population, and it wasn't until the creation of the actual National Meteorological Service that reliable and systematic record of events were available, increasing in detail during the twentieth century including the social and economic effects as new governmental institutions were created to manage water.

Secondly, even considering the sparse information available, the effects of droughts are being accounted for by specialists that consider they were major drivers on the demise of the ancient prehispanic cultures in Mexico. Droughts during the colonial period are considered key factors in the social and economic context that derived in political conflicts, mainly the war of independence that initiated just at the end of a drought in the states of the bajo region where most of the insurrection took place.

After the war for independence and several other civil conflicts concluded, by the end of the nineteenth century Mexico gained some stability; the available data from that era shows impacts of drought on agricultural activities, which at the time included the majority of the population, thus with significant impacts on the entire society.

Finally, the reactive approach to address the problem can be highlighted notwithstanding the fact that drought presented cyclically affecting vast regions and sometimes almost everywhere in the country, some of the mitigation and even adaptation measures were developed and used during the different events, but the decisions were made on a case by case basis, without a national policy that could be used to systematically improve the efficiency of the programs despite considering preventive measures to address a recurrent problem.

1.2. The 2010-2013 drought and the old approach

Extending over 90 % of the Mexican territory with different severity levels, and considered the largest drought on record since the beginning of climatic data in Mexico, beginning in 2010 and lasting through mid-2013 it represented an enormous challenge to the Mexican government that was barely recovering from the economic world crisis of 2008-2009. The effects were felt mainly in the rural communities and areas without irrigation, but impacted several economic activities associated with agriculture and cattle ranching (GINER, 2011).

The states where the drought lasted longer were northern states: For Durango and Aguascalientes it was the worst drought on record, for Guanajuato and Zacatecas it was the second driest year on record, and for Coahuila and Baja California Sur it represented the third driest year in their climatic record, for the state of Nuevo Leon was the fourth rainless year and the fifth for the state of Chihuahua, for some states like Sonora that have extremely arid conditions it only scored as the ninetieth parched year on record (Table 1).

Migration, unemployment, lack of food and water in small rural and isolated communities felt the impact depending upon the different levels of drought through the period, in some areas it was a mild drought, and yet in some southern regions of the country the phenomena lasted only for a few months, still, it mobilized political and governmental actors throughout the country.

Tabela 1. Precipitation anomalies for northern states in Mexico. Source: (CONAGUA, 2011).

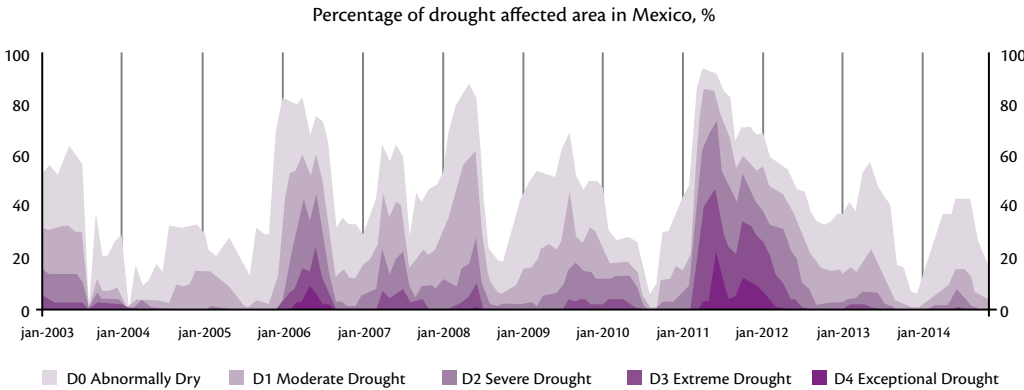
States	Precipitation Anomalies	Precipitation January - December 2011	Average precipitation	January - December
	Percent	mm	mm	Period 1941 - 2011
Durango	-51.1	245.7	502.4	1 ° + driest
Aguascalientes	-44.4	257.8	463.8	1 ° + driest
Guanajuato	-38.5	378.6	615.4	2 ° + driest
Zacatecas	-39.1	314.4	516.6	2 ° + driest
Coahuila	-47.5	176.1	335.4	3 ° + driest
Baja California Sur	-60.4	70.5	178.2	3 ° + driest
Chihuahua	-40.2	259.2	433.1	5 ° + driest
Nuevo León	-39.0	374.7	614.1	4 ° + driest
Sonora	-14.8	359.7	422.4	19 ° + driest

Alarms went off in 2010 as a result of the drought monitor in place since 2003, when the governments of Canada, United States and Mexico agreed to work together sharing information and models to prepare the North American Drought Monitor. Several high level meetings were held within the Mexican government to prepare for the event that was properly signaled, but at the time it was hard to predict either duration or extent over the country. The percentage of

coverage of the land and the drought levels are presented on Figure 1, which includes available records since 2003 from the drought monitor.

During 2011 the federal government aligned resources for the second half of the year to begin with some mitigation measures which included infrastructure construction and financial and insurance coverage support for affected areas, some temporary jobs were offered and restrictions for water allotments on irrigation districts were in place as well as recommendations for less water consuming crops.

An intense political fight was evolving while the effects of the drought were felt all over the country, states and legislators didn't know how to react, for instance, legislators had to approve the 2012's budget and didn't include provisions to attend the crisis, less than a month later, some legislators were demanding extra money from the federal government to attend the emergency.



**Figure 1.** Percentage of drought affected area in Mexico 2003-2014.

Source: (CONAGUA, 2014).

The only policy in place to deal specifically with drought involved two mitigation funding mechanisms: the National Fund for Natural Disasters (Fonden), that have specific rules that include assessment of drought effects during December at the beginning of the dry season, and the Attention Component for Natural Disasters for Agriculture and Fishing Sectors (Cadena), both of this funding mechanisms depend upon predetermined set levels from the Streamflow Drought Index (SDI), and the Standard Precipitation Index (SPI).

Giving the extent and impact of the ongoing drought, the federal government reacted with the implementation of a presidential decree in January 2012 that organized several programs within the federal government from different ministries to deal with the 2011 drought effects; a two tier approach was defined: one set of measures aimed to protect production and infrastructure, and another for humanitarian help to families and communities affected by the different levels of drought.

The humanitarian component included: water and food for affected communities and family income protection; the productive component incorporated: Temporary employment on affected areas, insurance protection for lost crops and livestock deaths, maintain production capabilities, financial support for economic activities in affected areas, and finally sound and sustainable use of water.

Regardless of the collaboration between state, municipal and federal governments, and the coordination of at least five ministries and three other federal offices from the federal government: Secretariat of Communications and transport (SCT); Secretariat of the Environment and Natural Resources (Semarnat); Secretariat of Agriculture, Livestock, Fisheries and Food (Sagarpa); Secretariat of Social Development (Sedesol); Secretariat of Finance and Public Credit (SHCP); National Water Commission (Conagua); FIRA (Trusteeship related with agriculture); and Rural Financial, the approach was undoubtedly reactive, and showed its limitations, therefore new ideas began to be considered to tackle future events in a more proactive and preventive perspective.

### 1.3. The international context

Mexico initiated collaboration with Canada and the United States through Conagua back in 2002 in order to generate the North American Drought Monitor, and since then keeps several collaboration activities with international organizations, in particular the World Meteorological Organization (WMO) for training and skills development, supporting the Meteorological National Service (SMN) and the technical areas dealing with extreme events: flooding and drought.

During the Conference of the Parties of the United Nations Framework Convention on Climate change (COP) 16 held in Cancun, Mexico in 2010, the Mexican delegation proposed that water adaptation measures were included as part of the working agenda, this was a significant step in the paradigm change from mitigation to adaptation strategies considering that climate change impacts are felt first on extreme events associated with water, the same proposal was made at different international forums (CONAGUA, 2012a).



Conagua personnel participated at the experts meeting held in 2011 “Towards a compendium on National Drought Policy” Convened by WMO, George Mason University, the Environmental Science and Technology Center, the National Drought Mitigation Center (NDMC), and the United States Department of Agriculture (SIVAKUMAR et al., 2011). The 2010-2013 drought was an event that impacted not only Mexico but several countries at different levels, experiences were shared and the need of a paradigm reform on national policies was a major conclusion.

The experiences of Spain, several states in the United States, Australia, India and China were studied and considered as reference to develop the prevention and mitigation strategies for drought in Mexico, particular attention was placed on the California and Colorado experiences for the drought planning developed, as well as the policies existing in Texas for some of their public water systems (SIVAKUMAR et al., 2011; WMO and UNCCD, 2012; City of San Antonio; CWCD and NIDIS, 2012).

While Mexico was designing the new policy towards drought, the High Level Meeting on National Drought Policy (HMNDP) was held in Geneva in March 2013. The Mexican delegation participated and approved the documents emanated from that meeting and they were used as a reference in the ongoing efforts to define the Mexican National Drought Policy (HMNDP, 2013).

Besides, the process that occurred in Mexico arouse interest in the World Bank, WMO, Brazil, Turkey and other Latin American countries so Mexican experts attended several regional and international workshops and offered technical assistance.

Overall, the alignment of the severe drought impacting Mexico together with the international efforts where Mexico actively participated, both on National Drought Policy, as well as water adaptation measures regarding climate change created a timely synergy for a very interactive process incorporating local and international experiences.

## 2. Theoretical framework considerations

Considerations of paradigm shift are to be taken very seriously, not only because the long time and complex process involved in such endeavor (KUHN, 1962) but because the inertial and incremental adaptations that dominate governmental affairs makes it even more complicated than just a conceptual redefinition in academic terms. The long history of governments reacting to drought events instead of preventing them, and the relatively recent use of concepts involving risk management, reduction of vulnerability, adaptation measures and prevention as part of the

drought policies worldwide set the stage for the level of difficulty involved in shifting “from passive crisis management to proactive risk management” (HMNDP, 2013).

The theoretical framework to analyze the creation of this public policy may be considered post-positivist according to the description in Torgerson (1986), with a concerted effort among governmental officials, professional experts and academics developing the core of the policy, including a strong technical background and experience of dealing *in situ* with real drought events, but also with a definitive aim to generate public participation in the generation of initiatives to be used at the watershed level.

Another theoretical perspective that resonates closer to water policy efforts is provided by *Civic science* (SCHMANDT, 1998) which argues that complex problems like drought need to be assessed with the best knowledge, therefore the need of experts, but the solutions to utilize the initial assessment need to be planned involving stakeholders; in our case local representatives and water users, as well as federal authorities are stakeholders and were included in defining the preventive measures considered for each particular case.

The principles considered the backbone of the policy respond to this theoretical considerations as well as the process defined to create the main elements of the drought policy.

The principles outlined are:

- Preventive approach: It drives the policy shift from a reactive perspective towards risk management. Entails monitoring and information outreach so that it can be used by authorities and stakeholders to implement previously defined measures after certain thresholds aimed to cope with less water; also involves vulnerability baseline definitions to evaluate the risk at different levels of contingency.
- Decentralization: A basic goal of the policy is to involve local stakeholders since the problems can be prevented better at the affected community level, nevertheless Institutional as well as citizens' training and empowerment is required since the current top down approach usually leave communities without the proper preparedness and resources to handle drought.
- Governance: The watershed council structure is in a way a form of governance, and the goal is to use that institution to strengthen governance required for drought prevention and mitigation; involving local universities supporting technical decisions of stakeholders and authorities provide the basis of public participation and stronger governance needed to reduce vulnerabilities.

- Training and research: The paradigm shift and decentralization requires understanding and proper training of the new concepts involved in risk management, and the lack of baseline information on vulnerability, drought impacts and extreme event forecasting and understanding impels the need for research.
- Gradualism and evaluation: This concept aims to build a transitional process between paradigms, breaking away from inertial attitudes, development and evaluation of performance indicators should be used in a process of continuous improvement.
- Institutional coordination: One of the obvious problems of reactive policies compared to preventive approaches involve lack of procedures of institutional coordination, and drought complexity implicate a vast number of governmental ministries, offices and programs, and structural shifts can only be implemented through good and systematic coordination.

The process involves two major elements developed according to the principles listed before, they address the current drought situations and the transition from certain reactive institutions and rules to the new mechanisms designed for the new paradigm:

1. Elaboration of Drought Prevention and Mitigation Programs (PMPMS) in every watershed council in the country.
2. Mitigation measures to face ongoing drought emergencies.

The paradigm shift involves a policy shift while multiple governmental and cultural given ongoing activities exist, as Khun (1962) clearly explains there is a transitional period where both paradigms coexist, the key to move from one paradigm to the new one consist of consciously using the existing institutional framework as long as it is needed to create the new institutions and rules that will regulate drought policy in the future, this will be attained by identifying the old institutions that need to be substituted and a careful management of change through training and capacity development, both institutional and personal.

### 3. Mexican National Drought Policy

In January 2013, at the beginning of the new federal administration, the president of Mexico Enrique Peña Nieto instructed the National Water Commission (Conagua) to implement the National Program against Drought (Pronacose), the decision was made to design a National

Drought Policy (NDP) moving from a reactive to a preventive approach. By that time the last remains of the 2010-2013 drought were still felt in some northern states, and the existing policies and rules of operation for drought emergency programs were in place, therefore a two component program was designed and implemented: The generation of the PMPMS and the installation of the Intersecretarial Commission for the Attention of Drought and Flooding.

The design and development of the NDP was a very interactive task, through the implementation of the Pronacose most of the elements felt in place along the way, with multiple modifications and adjustments because of their inclusive nature, and also because adjustments were needed to adapt international experiences to the national institutional framework and regional characteristics, a simplified diagram of the NDP is presented in Figure 2.

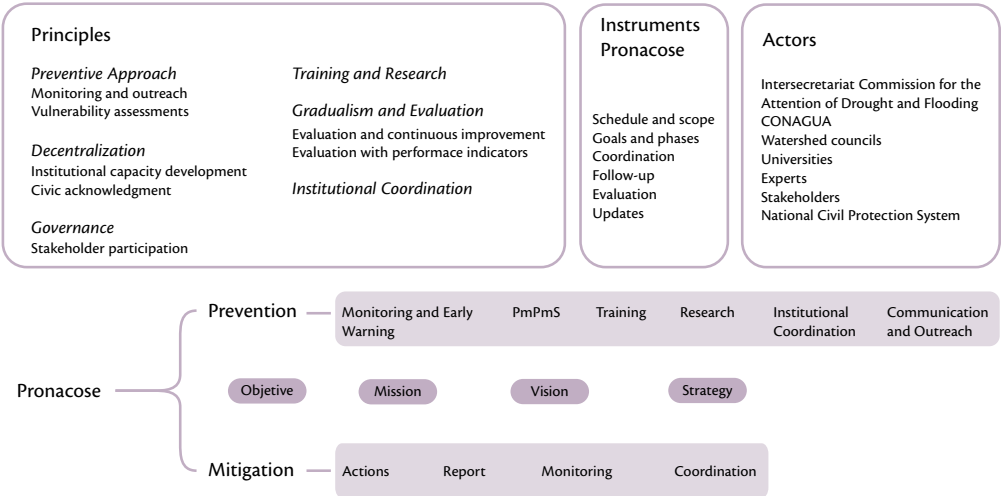


Figure 2. National Drought Policy Diagram

### 3.1. Pronacose

The main objective of Pronacose is to develop the Drought Prevention and Mitigation Programs (PMPMS) and address the drought events at the watershed level, develop institutional local capacity while simultaneously coordinating and implementing drought mitigation activities as needed as well as promote drought research and build an historical archive.

Pronacose's mission is to develop the basis for the paradigm shift on drought attention in Mexico, from reaction to prevention, proactive and based on risk management while attending the current drought events.

The vision of the program entails guaranteeing planning and implementation of drought measures, involving public participation in the definition of actions to reduce vulnerability as a pillar for the Mexican strategy on climate change adaptation expressed in the Climate Change General Law, the National Waters Law and linked with the National Civil Protection Service activities.

The program envisions that every watershed council will have a PMPMS and periodical evaluation and updates involving members' participation to improve the programs, with Interinstitutional coordination instruments at the national level to prevent and oversee contingencies.

The strategy to implement the policy consists on gradually decentralizing drought attention involving stakeholders through the watershed councils, also pair them with teams of academic experts from local universities, the goal is to develop local institutional capacity and begin to change the old reactive top down approach to address drought.

PMPMS are the main instrument to carry on the strategy, and the aim is that once they are assumed and implemented by the watershed councils, they will move to delineate more specific programs for cities or irrigation districts within the watershed council, the PMPMS need to be evaluated and improved with an specific schedule to assure that the first renewed programs will be ready before the federal administration ends and seasoned to continue regardless of administration change.

While the PMPMS are in place and enough institutional capacity exists at the local level, the Interministerial Commission will be in charge of coordinating federal mitigation activities.

Another key element of the strategy includes constant feedback with and from international entities and experts which may help to enhance the quality of the policy developments.

The process to master the elements of the NDP began right after the presidential instruction, some of the people involved during the ongoing drought were called to assemble ideas on how to implement the paradigm shift while coping with the existing drought, some legal guidelines for drought attention were approved at the end of the previous administration and were used to have the basic definitions of the phenomena (Diario Oficial de la Federación, 2012).

The technical staff of Conagua and the contacts with the watershed councils were convened to prepare for the new policy approach, also academic experts were invited to develop training courses and analysis of national and international experiences on drought management to be used for capacity building. At the same time the legal framework to create and install the Interministerial Commission was prepared with the legal office of the president.

The issues over the early warning system were addressed during the first technical discussions, and it was decided to have two different approaches, for the new policy and the ongoing mitigation efforts the drought monitor will be used to activate alarms and define the drought severity stages, on the other hand, the SPI and SDI will be kept to run the mitigation programs FONDEN and CADENA.

The participation of Mexico on the HMNDP at the early design stages was essential to engage with the evolving international efforts and continued with interaction at subsequent forums where the Mexican experience was also considered by other international experts and governmental representatives. Mexico became a member of both the advisory and management committees of the Integrated Drought Management Programme (IDMP), and the Mexican case was part of the “National Drought Management Policy Guidelines” published by the IDMP (2013). Conagua also participated invited by the World Bank and the WMO to present the Pronacose experience at Brazil, Central America and Turkey.

Several training courses were held involving Conagua’s technical personnel from the 26 watershed councils together with academics from 12 different universities throughout the country, some were face to face, while others were through video conferences, the aim was to agree on the basic premises contained in the guidelines, from these early stages accompaniment and counseling by national and international experts was part of the process.

Besides the Conagua’s guidelines used by the universities and the watershed councils to develop the PMPMS, a detailed supervision tool was developed also to help them comply with the ambitious process and schedule proposed to elaborate the programs, also a site was developed to have online materials, reports, information and multimedia tools for everyone to use: [www.pronacose.gob.mx](http://www.pronacose.gob.mx).

The PMPMS content was defined in the guidelines to have a minimum standardization reference, succinctly summarized it included the following:

- Abstract
- Presentation

- Watershed characterization,
- Task force definition within the watershed council to coordinate and follow up on the elaboration of the PMPMS
- Objectives definition
- Droughts' history and assessment of their impact
- Vulnerability assessment
- Mitigation and response strategies
- Drought phases
- Triggers and measures' objectives
- Specific program with measures for every drought phase
- Implementation
- Monitoring
- Conclusions
- Annexes

The process defined to elaborate the PMPMS in every watershed council should include the following steps to be accomplished in about nine months, noteworthy some of the steps correspond to sections of the report content: Training workshop to launch the Pronacose, a letter of intention of the participating institutions, contact with the technical director of the corresponding basin organization, organization of the directive task force (GTD), work plan and organizational chart, a general report on drought history on the basin and its impacts, characterization of the basin, report on the basin vulnerability, mitigation and responses expected for drought management, phases and associated indicators' characterization, detailed program for every phase, first version of PMPMS, agreements with stakeholders on at least three different meetings, final version of PMPMS, and implementation.

The process involved participation of stakeholders in the definition of measures to be implemented at different stages of a drought according to the predefined indicators, the initial proposals were presented to them by the experts at the university in consultation with the technical personnel from Conagua, thus generating a very interactive process that involved knowledge and argumentation about the alternatives, and some negotiation based on the measures that the stakeholders were willing to apply in their basin.

The principles of decentralization, governance, training, gradualism and institutional coordination are all considered within the process of building the PMPMS, with the purpose

of reorienting the drought management policy. The first version of PMPMS are intended to be a good approximation, in other words, a tentative first draft of what is expected to be an accepted, adjusted and viable program to be implemented in the following years after their first implementation and evaluation, the process is designed considering gradualism through the transition to achieve the policy shift.

### 3.2. Interministerial Commission for the Attention of Drought and Flooding

An extraordinary achievement for the benefit of the policy implementation was the creation of the Interministerial Commission (IC) which also helped to organize and coordinate efforts for the ongoing drought, the fact that was convened at the beginning of a federal administration was extremely important, since it helped to generate a different approach with the new cabinet members towards the policy shift.

The Commission was installed in April 2013 and included fourteen secretariats and federal offices: Chaired by the Secretariat of Environment and Natural Resources (Semarnat); Secretariat of the Interior (Segob); Secretariat of National Defense (Sedena); Secretariat of the Navy (Semar); Secretariat of Finance and Public Credit (SHCP); Secretariat of Social Development (Sedesol); Secretariat of Energy (Sener); Secretariat of Economy (SE); Secretariat of Agriculture, Livestock, Fisheries and Food (Sagarpa); Secretariat of Communications and Transportation (SCT); Secretariat of Health (Salud); Secretariat of Rural, Territorial and Urban Development (Sedatu); Electricity Federal Commission (CFE), and National Water Commission (Conagua) as the executive secretariat.

One of the first tasks of the commission was to install a committee to review all the federal programs that might have an impact on drought, this exercise led to the identification of 114 programs, 19 out of those were reviewed together with the two funding protocols from Segob to address drought impacts: Fonden and Preventive Trusteeship (Fipreden), they were examined in detail among the federal programs and explored the potential reorganization and modification to avoid duplication and enhance efficiency of federal actions to handle drought (OMM, 2013). Modification of the programs' rules of operation is the next step to align them with the new approach.

Another agreement of the IC was to create a technical experts' committee to provide counseling and evaluation to the Pronacose activities, discuss and propose the research agenda needed to strengthen the understanding of drought; also all the federal secretariats agreed to provide research funding on selected topics. The agenda is under IC members analysis and it is expected to be approved early 2015.



The Commission also served as the coordination tool for all the mitigation activities that the federal government implemented during the last part of the long drought.

### 3.3. Policy instruments

The implementation of Pronacose is the main instrument, but with specific schedule and scope, goals and phases, coordination, follow-up mechanisms, evaluation and updates, and the coordination instrument is the Interministerial Commission; the experts committee will help evaluating the programs reviewed by every watershed council, the goal is to update the PMPMS's at least once after their first implementation.

To succeed in the main goal of policy shift, a detailed program to transcend the federal administration was conceived, which includes the elaboration of the first version of the PMPMS's and its continuing evaluation and improvement.

Another key element is to make sure that the Pronacose becomes part of the National Civil Protection System (SNPC), particularly for the early warning system, the system is already in place for flooding, but the distinct characteristics of drought events makes it harder to call for emergency preparedness meetings and protocols as it is done for flooding events, currently the SNPC works for mitigation activities and emergency response when the drought effects are well on their way affecting communities, and the challenge is to utilize the early warning system at different stages to initiate people preparedness and reduce vulnerability.

The phases defined for the Pronacose implementation consider that the first year the first version of the 26 basins' PMPMS will be completed, the Interministerial Commission in full operation, and the basic training and agreements with watershed council members concluded.

The second phase which expands a two year period includes the elaboration of the first PMPMS for two cities on each basin, the research agenda definition and development of vulnerability evaluation criteria, also a media campaign to present and publicize information about the PMPMS and finally begin interaction with the SNPC to implement early warning protocols for the different basins.

The third and fourth phases are designed to evaluate and update the PMPMS's and develop PMPMS's at the water utilities level, as well as in coordination with the SNPC integrate the risk atlas with drought information on vulnerabilities and protocols.

The fifth and sixth phases are intended to 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.

So far the implementation of the Pronacose is on its third year, at the middle of the second phase, all the PMPMS's were completed, and most of the PMPMS intended for at least two water utilities per basin are finished, also all the institutional coordination and advisory mechanisms are working, including the Interministerial Commission, the committee to review the federal programs, and the experts committee, also the research agenda has been defined with consensus about the topics to get funding from several secretariats, and finally the early monitoring system is working too.

## 4. Findings and preliminary conclusions

The use of the principles defined to develop the Mexican National Drought Policy created synergy among them, the ambitious goal of having a policy shift seem to be advancing consistently breaking some of the inertial attitudes at the basin councils and the federal government, but the final test should be implementing the PMPMS before and during a drought event so they can be proved and enhanced.

The inclusive effort aimed to decentralize the program strengthened governance, and the emphasis on training also improved the capacity building needed for decentralization, while research created an incentive for the universities and experts to participate and embrace the program, and the Interministerial Commission enabled the different areas of the federal government to gradually assume the policy shift.

Some challenges that need to be carefully considered appeared while in the process of definition and implementation of the policy, some may be possible to tackle through mild adjustments, others might not be solved in the near future but still it is important to identify them and look for alternative ways to answer them.

Four main drivers for change can be identified in the process: The 2010-2013 drought event was the main source of political momentum and the first driver; the existence of a long period of drought presented the opportunity for a strong political attention and deployment of several programs and institutional instruments to manage the crisis.

The second driver emerged during the emergency response given to the phenomena, since it exposed the limitations of a reactive approach, leading the Conagua technical personnel to consider a shift of paradigm along the terms of adaptation and preventive measures in the wake of climate change that the Mexican government was pushing at the time.

At the same time the Mexican participation and technical assistance offered at expert meetings convened by the WMO and other UN offices, foreign countries and universities to address the convenience of risk management as the cornerstone for National Drought Policy synergized the new policy in Mexico constituting the third driver.

Last but not least, the change in federal administration presented the political opportunity for a new approach; the definite impulse given by the President of Mexico streamlined the process and helped to quickly implement the Pronacose, the Interministerial Commission for the Attention of Drought and Flooding, while the ongoing drought event persisted through the first semester of 2013.

There are challenges too, the rainy season on the second semester of 2013 and the confluence of Hurricanes Ingrid and Manuel that hit Mexico from the Atlantic and the Pacific on September 2013 shifted completely the political attention and priorities, nevertheless the previously existent momentum helped to continue and finish the 26 PMPMS's later that year, but the retrieving drought impeded the implementation of the PMPMS's measures stalling their evaluation and potential adjustment.

The situation resembled quite clearly the famous "Hydro-Illogical Cycle" diagram proposed by Wilhite (2011), where it does not matter how hard the drought event was once the rain comes things go back to a "business as usual" attitude.

The institutional design of the Interministerial Commission for the Attention of Drought and *Flooding* (emphasis added) was an unintended favorable circumstance, because of the hydrologic conditions in Mexico in 2013 and 2014 and helped to consolidate the institutional coordination mechanism for drought.

In terms of opportunities maybe the least developed effort was publicizing information, since it has been restricted mainly to members and representatives that participate in the basin councils, outreach efforts need to be improved so that the public can be eager to participate on the measures defined by the PMPMS, one way to solve this weakness will be the incorporation of early monitoring systems and protocols to the National Civil Protection Service (SNPC), where media broadcasts timely information to the public.

Another possibility to improve education on drought issues, understanding and preparedness using early monitoring systems, and reducing vulnerability will be to involve the Ministry of Public Education that currently it is not part of the IC; in any case, educational programs might be included gradually as part of the basic educational curriculum.

Publicize national drought management policy and preparedness plans, build public awareness and consensus, and develop educational programs for all age and stakeholder groups are included as important steps on the recommendations published by the IDMP (WMO and GWP, 2014) and apparently they need to be strengthened for the Mexican case.

The modification of Fonden, Fipreden and Cadena is one of the main challenges that remain, since these programs were crafted considering a predefined amount of money available for response, it is hard to adjust them for preparedness, or structural changes that will reduce vulnerability and reduce the need for reconstruction or mitigation funds, they are the institutional remnants of the old policy approach, and they need to be kept functioning while a different set of rules are designed for the new policy. Also the link with the national crusade against the hunger represents a window of opportunity to reach those communities less developed with a joint goal of reducing their vulnerability. Another challenge that remains unfulfilled is homogenization of criteria for vulnerability assessment, currently there are several methods used and debate about pros and cons is very much alive, it will be important to reach some consensus about it considering the importance of evaluation and improvement.

Risk management need to be calculated based on quantifiable impacts, thus having data bases and models that will help us estimate how much money, resources, and lives are saved by using this approach rather than keep reacting to drought crisis is paramount.

A different set of limitations for the new policy are more difficult to overcome because of their structural character, like the level of complexity of the watershed boundaries not corresponding to the states' political boundaries, which makes difficult the definition of priorities and budgets; or political constraints akin with reluctance of local authorities to embrace management risk instead of reacting to emergencies because populism and clientele fare better under critical circumstances.

The extraordinary velocity for the implementation of Pronacose, including the completion of PMPMS for the entire country and the construction of a basic institutional capacity at the basin council level, the installation of the Interministerial Commission and related coordinating committees, and having an operational early warning system makes the Mexican experience a strong novelty on National Drought Policy building and international focus.

The sudden cease of the long preceding drought imposed a halt on the implementation of the newly developed measures contained on the PMPMS, which will have to be improved once they are put to the test under real drought circumstances. On the other hand, this pause gave enough room to review and discuss vulnerability assessment methodologies, accomplish specific PMPMS for around 50 cities throughout the country and define topics and funding for further research on drought related issues.

Finally, the continuous international interaction of Conagua on drought policy workshops, conferences and forums provide a useful vehicle to evaluate and improve their own policy using experiences from different world places.

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