



Extreme Drought in Puerto Rico: Lessons Learned

XXV Annual CWWA Conference
Trinidad and Tobago
October 24-27, 2016

Carl-Axel P. Soderberg, P.E
Member, Advisory Council

Inter-American Association of Sanitary and Environmental Engineering
(AIDIS)



💧 **1,812 m³/inhabitant/year**



EXACERBATING FACTORS LIMITING AVAILABILITY OF WATER IN PUERTO RICO



SEDIMENTATION OF RESERVOIRS

Key reservoirs have lost significant storage capacity due to sedimentation

- 💧 Carraizo Reservoir – 50%
- 💧 Dos Bocas Reservoir- 63%



WATER HYACINTHS

💧 Surface area of reservoir covered with water hyacinths exhibits an evaporation rate between 7 and 10 times higher than areas not covered by this aquatic weed.



UNACCOUNTED WATER

💧 55%



SALT WATER INTRUSION

Groundwater availability has been negatively impacted by over pumping of aquifers.

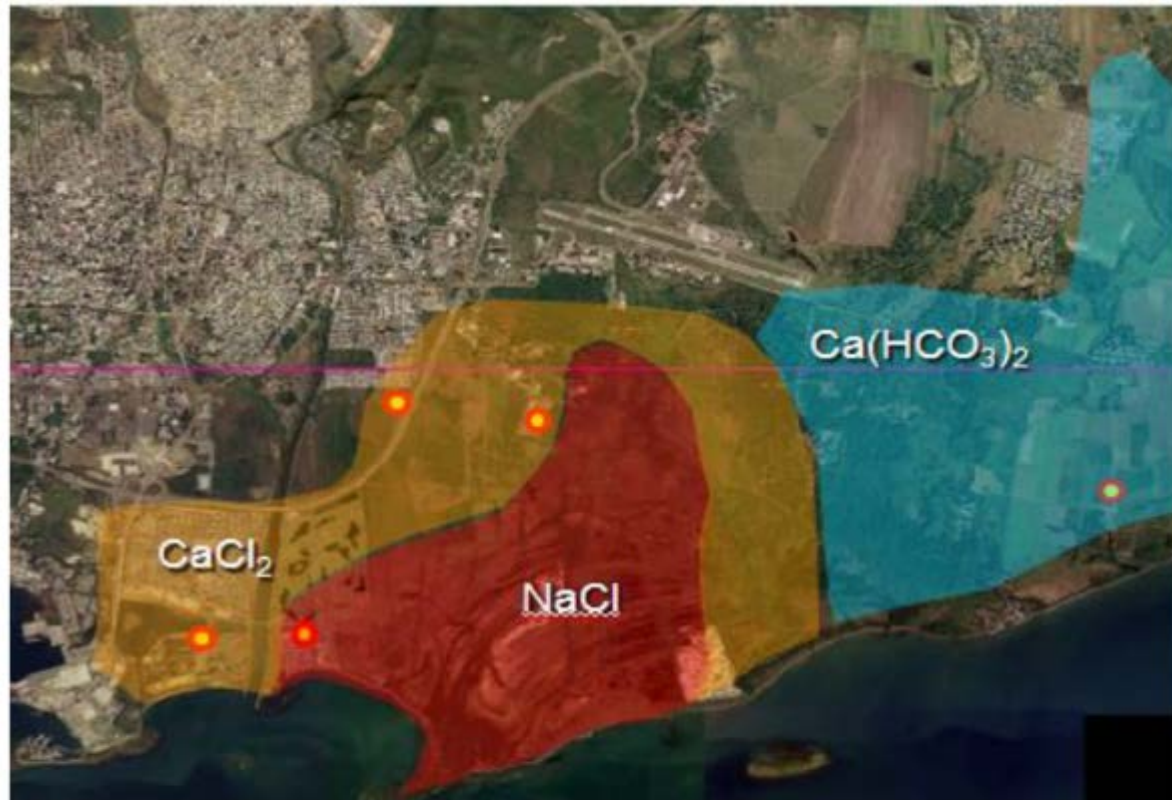


Ilustración 2. Mapa de la condición hidroquímica en el acuífero del área de Ponce, año 2012. Los puntos rojos representan los pozos cuya agua fue analizada por el USGS. (Fuente: Rodríguez & Gómez, 2009).

MANDATORY WATER RESERVES FOR ECOLOGICAL NEEDS

- ◆ Since the 1990's environmental statutes require that minimum flows be maintained in rivers and streams to address ecological needs.



2015 EXTREME DROUGHTS

Three Consecutive Years of Rainfall Deficit

- 💧 Year 2013- 10% less rainfall
- 💧 Year 2014- 20% less rainfall

MEASURES TO COPE WITH THE EXTREME DROUGHT

Curtailed Use of Water

- 💧 The Puerto Rico Aqueduct and Sewer Authority (PRASA) issued an order prohibiting the use of utility water for construction; sand blasting; cleaning of roofs, sidewalks and carports; filling swimming pools; watering lawns and plants; washing cars; among others.

MEASURES TAKEN TO COPE WITH THE EXTREME DROUGHT

Expedited Fixing of Broken Pipes

- Additional crews were established. Citizens were encouraged to report broken pipes through 1-800 telephone number or twitter account



MEASURES TAKEN TO COPE WITH THE EXTREME DROUGHT

Water Rationing

- 🔥 Mid-May-
 - 🔥 24 hours without service, eastern portion of San Juan Metropolitan Area (SJMA)
- 🔥 Mid-June-
 - 🔥 24 hours w/o service western end of SJMA
 - 🔥 48 hours w/o service eastern end of SJMA
- 🔥 Beginning of July-
 - 🔥 24 hours w/o service in towns located in eastern P.R.
 - 🔥 12 hours w/o service southern P.R.
 - 🔥 48 hours w/o service western end of SJMA

MEASURES TAKEN TO COPE WITH THE EXTREME DROUGHT

Water Rationing

- ◆ Beginning of August
 - ◆ 72 hours w/o service eastern end of SJMA
 - ◆ 24 hours w/o service southern P. R.
- ◆ Beginning of September
 - ◆ 72 hours w/o service seriously considered for western end of SJMA
 - ◆ 144 hours w/o service seriously considered for eastern end of SJMA

MEASURES TAKEN TO COPE WITH THE EXTREME DROUGHT

Establishment of Water Distribution Stations

- ◆ Eastern end of SJMA- 44
- ◆ Western end of SJMA- 39
- ◆ Mayors supplemented water distribution stations with truck service to the elderly and handicapped



MEASURES TAKEN TO COPE WITH THE EXTREME DROUGHT

Price freeze

💧 The Department of Consumer Affairs froze prices of cisterns, appurtenances needed for installation of cisterns, bottled water, anti-bacterial soap, plastic eating utensils, water storage tanks, and ice, among others.

Daco ordena congelación de precios

PH Por Primerahora.com
05/08/2015 | 11:24 a.m.

f Me gusta 2197 t Twitter G+ Compartir 1

A- A+



La medida se toma ante la posibilidad del racionamiento de agua. (Archivo)

La lista incluye agua, hielo y cisternas, entre otros productos necesarios para una "situación de emergencia".

Debido a la sequía y al plan de racionamiento de agua, el secretario del Departamento de Asuntos del Consumidor (DACO), Nery E. Adames Soto, firmó una orden que congela los precios de

MEASURES TAKEN TO COPE WITH THE EXTREME DROUGHT

Fines for Inappropriate Use of Water

- PRASA established by Mid- June a regulation to impose fines for inappropriate use of water during droughts. A fine of up to US\$ 250 could be imposed to individuals. A fine of up to US\$750 could be imposed to government and private entities.

MEASURES TAKEN TO COPE WITH THE EXTREME DROUGHT

Cloud Seeding

PRASA contracted a company with experience in cloud seeding in the mainland USA. The results of this effort are still being debated.



MEASURES TAKEN TO COPE WITH THE EXPERIENCE DROUGHT

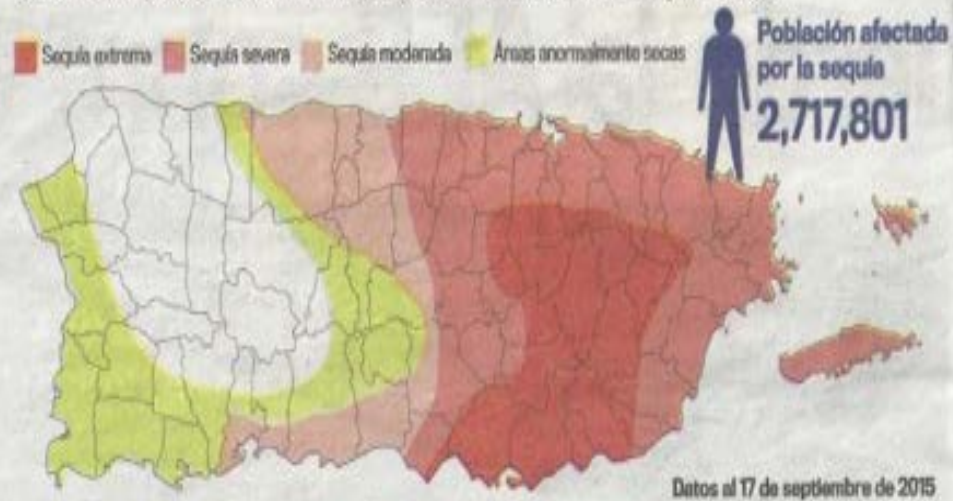
Intensive Education Campaign to Conserve Water

- 💧 PRASA unleashed an intensive television, radio and television media water conservation campaign.

LESSONS LEARNED

Se agrava el problema

Veintiséis municipios de Puerto Rico se encuentran oficialmente bajo un patrón de sequía extrema



FUENTE: Monitor de Sequía de Estados Unidos • GRÁFICA: EL NAVEGO LCA



LESSON LEARNED #1

A Continuous Education Program is a Must to Achieve a Water Conservation Culture

- ◆ Education campaigns during droughts only have short term effects. If we want to establish a water conservation culture, a continuous and multifaceted education effort is a must.

LESSON LEARNED #2

Fines for Improper Use of Water Must be Imposed by Day One

- ◆ Unfortunately there are some individuals and entities that continue to use water ignoring the drought and public appeals to conserve water.

LESSON LEARNED #3

Equity in Suffering

- ◆ All sectors of society are willing to share the burden of rationing if everybody suffers service interruptions. Protest arise and incidents involving improper use of water increase if certain areas are not subjected to rationing.

LESSON LEARNED #4

Implement EPA's WaterSense Program

- Water demand in homes can be reduced by 40% without sacrificing quality of life if EPA'S WaterSense Program is implemented. If this program had been implemented Southern Puerto Rico, there would have been no need to establish water rationing.



Certified by
CSA International

LESSON LEARNED #5

Significantly Increase Wastewater Reuse

- ◆ Puerto Rico must significantly increase wastewater reuse for irrigation of crops; irrigation of parks, green areas and golf courses; industrial processes; salt water intrusion barriers; and aquifer recharge.



LESSON LEARNED #6

Significantly Reduce Unaccounted Water

💧 A program must be established to reduce unaccounted water to the industrial standard of 17%.



LESSON LEARNED #7

Mandatory Water Harvesting

- ◆ Water harvesting was done in the past in Puerto Rico. The Government of Puerto Rico should enact legislation making water harvesting mandatory.



For more information you can contact me at

AIDIS-Puerto Rico

(787)-793-2691

Email: aidispuertorico@gmail.com

THANK YOU

