Drought Prevention

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***Abstract* - Drought is the most complex and least understood of all-natural hazards, affecting more people than any other hazard. For the past several decades, we have been reminded again and again of the ravages of drought and the inability of most societies to effectively mitigate impacts in the short term and reduce vulnerability in the longer term. In fact, most scientists would agree that vulnerability to drought is increasing for a number of reasons, the most important of which may be the increasing pressure of an expanding population base on limited water and other natural resources.**

Keywords-Point drought; Regional Drought; low-flow analysis;

I. INTRODUCTION

The adverse effects of drought on both water supply systems and environment, are expected to increase in the coming years. In fact, even without referring to the controversial matter of climate change on a world scale, water resources present a natural variability from year to year, so that the risk of severe water shortage in all domains of water use becomes greater as the water demand increases. Implementation of adequate measures to control and/or mitigate drought consequences is recognized as a major matter challenging researchers and scientists involved in the water resources management. A comprehensive approach for studying drought problems includes, among others, the following topics: (i) identification of meteorological causes and drought forecast; (ii) evaluation of hydrologic drought characteristics at a site and over a region; (iii) analysis of economic, environmental and social effects of drought; (iv) definition of appropriate measures for mitigating and controlling drought effects. Although no analytical literature survey of droughts is attempted here, an outline of the most important philosophies in drought evaluation is given below:

(a) Drought definition stage, in which several disciplines recognize the importance.

(b) G. ROSSI ET AL. of the analysis of such a natural hazard and try to identify the essential features of a definition of this phenomenon; among possible references, pioneering works include Eredia (1922), Blumenstock (1942) and Yevjevich (1967) fromthe hydrological point of view; Van Bavel (1953) and Palmer (1965) from the agricultural point of view; Tannehill (1947) and Russel et al. (1970),

from a socio-economic point of view; drought description stage, including methods for analyzing historical droughts; this aims at

- evaluating the risk of future droughts,
- determining the consequences on economy, environment, and society,

(iii)adopting measures for mitigating drought effects, regarding this stage, there are many references which could be mentioned, for instance Glantz (1966), Rosenberg (1980), Doornkamp and Gregory (1980), French(1983),Grigg and and Vlachos (1989), Dracup and Kendall (1991), etc.; integrated system approach stage in which the single variable and single discipline approaches are recognized to be insufficient for providing a good understanding of drought problems. Many attempts have been made for a more comprehensive analysis in order to characterize adequately this phenomenon and also for developing a more effective action against its consequences. As a reference for this stage, several books can be considered (Campbell, 1968; Warrick, 1975; Yevjevich et al., 1978), as well as the proceedings of several international symposia (Yevjevich et aL, 1983, Urbistondo and Bays, 1987; Wilhite et al., 1987; Siccardi and Bras, 1989; Tardieu and Plus, 1989). Despite the fact that hydrologic aspects of drought have been studied more extensively compared to the socio-economic and environmental aspects, a deeper knowledge of hydrologic characteristics of droughts is required as a basis for a better assessment of drought effects and for an adequate planning and implementation of effective mitigation measures. In this context, the topic of the hydrologic regional drought estimation seems to be worthy and particularly urgent. In fact, the areal and/or spatial variability of a drought over a region affect the drought definition itself. For instance, Yevjevich (1967) stated that a large areal coverage jointly with heavy deficit amount and long duration, allow us to distinguish 'drought' from other terms, such as 'water deficit' or 'shortage', which indicate events with lighter consequences. Besides, the increasing vulnerability of agricultural production due to water deficit and the development of large-scale multi-purpose water-supply systems, implies that drought analysis at a site is inadequate and a more comprehensive analysis at a regional scale is required. Finally, the need arises for using the whole set of available data in the gauging stations within a given region as in other types of hydrologic studies (e.g. in flood analysis).

II. IoT AND DROUGHT SENSITIVE FARMING

A. Water Planning for Droughts

Water usage laws most consistently come into play during drought season. Using Texas as a case study, we can see how agriculturalists must work with the earth to combat water shortages. According to the Texas Department of Agriculture, Texas has more farms and ranches than any other state, with 248,000 covering 130.2 million acres. Yet much of the state suffers from prolonged drought. On May 14, 2017, the National Drought Mitigation Center reported that topsoil moisture ─ a key indicator of soil readiness for agricultural activity ─ was rated "50% very short to short throughout Texas". In the lower Rio Grande Valley, topsoil moisture was "100% very short to short". This means that these farms were some of the driest in the United States and ill-equipped to grow crops or hydrate livestock.

Texas isn't the only state going through environmental extremes, however. Farmers all around the country are facing more prolonged droughts than ever before. Large swaths of Florida and California are in a severe stage of drought according to the National Oceanic and Atmospheric Association, and much of the south and southwest is undergoing moderate drought.

Even for states with regular rain, careful usage can serve as a preventative measure. From coast-to-coast, farmers and ranchers are turning to IoT for answers.

B. Precise Water Conservation with IoT:

In the past, drought management for farms meant waking up early, driving out to each irrigation site, watering hole, and water storage unit, collecting data manually, and analyzing it so as to plan out management of the remaining water. Because water use sites could be scattered across hundreds of acres, collecting water data could take the better part of a day to complete. To keep crops and animals hydrated, the task of manual water management becomes an endless cycle. Worse still, manual water management means either time away from the crops and animals or hiring an extra hand and stretching the farm's budget to pay for it.

Today, IoT can automate much of this process. A suite of devices working together can keep an agricultural center operating at peak performance even during periods of high drought. For instance, devices that monitor cattle movement can tell how often each animal is drinking, helping ranchers better manage animal hydration needs. Likewise, devices that monitor rain barrels can help ranchers keep track of water collection. Gauges even can tell a farmer when it is time to irrigate a specific quadrant of the farm.

In Southern California, avocado farmers already are using IoT to track soil moisture levels around their trees. Avocado trees are known for requiring plenty of extra water, and IoT technology makes it possible to automate sprinkler systems that shut off when the right amount of water has been administered so no water is wasted.

C. Faster Monitoring with Networked Systems

Checking IoT devices without connection to a network presents the same problem as having to manually check water levels: time is spent checking each device individually. Agriculturalists do not have time to regularly visit each device to collect data. Yet ranches and farms can cover hundreds of acres in remote areas not serviced by regular internet providers. Custom built IoT networks that connect each remote tool to a single point are the perfect solution. An integrated network of devices creates a complete tracking system that is ideal for farmers and ranchers, making devices check-ups as simple as pulling up an app for real-time performance data.

Farmers and ranchers can choose different networks to fit different needs. For instance, cellular networks present the best option for farms that have many devices collecting large amounts of data that farmers must respond to immediately. If you're farming 100 acres of fruit in a dry area, you may want a cellular network. But for farmers who just want the ability to receive updates on water levels once or twice a day, a low-power wide area (LPWA) network is probably the more cost-effective solution.

D. Drought is preventing trees from fighting climate change

In terms of curbing climate change, trees are man's best friend. As they grow, they pull carbon dioxide out of the air and convert it into sugars that add bulk to their trunks. This carbon storage ability is so well-known it has spurred an international tree-planting movement to slow global warming.

But drought could compromise the ability of trees to protect us from climate change, according to a new study. Scientists have shown that drought slows tree growth for many years beyond the initial dry spells, creating what researchers call a "drought legacy." And scientists trying to predict climate change "could be really missing the boat," if they are not including the effects in their computer models, says Melinda Smith, a community ecologist at Colorado State University, Fort Collins, who was not involved with the work.

To determine the true toll of droughts, Princeton University ecophysiologist William Anderegg and colleagues turned to the International Tree-Ring Data Bank, which stores 100 years or more of tree-ring data from more than 1500 nontropical areas of the world. In these temperate zones, trees lay down new trunk each summer but go dormant in winter, creating a pattern of rings that track the intensity of annual growth. The broader the area between two rings, the more productive the tree and the more carbon it stores.

The study represents our best understanding of how long the trees need to recover after drought disturbances at a broad range," says Yongguang Zhang, an ecosystems ecologist at the GFZ German Research Centre for Geosciences in Potsdam, who was not involved with the work. "Drought legacy effects will reduce our carbon storage in the future.

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