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SU VAKFI

Floods, Droughts And Their Impacts (Vulnerabilities, Fatalities, Economic Damage)

Taşkınlar, Kuraklıklar ve Etkileri (Maruz Kalma, Tehditleri, Ekonomik Zararları)

Zekâi Şen

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TURKISH WATER FOUNDATION
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TAŞKIN BÜLTENİ : SAYI 4

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Basıma Hazırlayan :
Muhiddin YENİGÜN

SU VAKFI

Libadiye Cad. Doğanay Sokak No:6 Kat:4 Üsküdar İstanbul
Tel: (216) 412 3383 - Faks: (216) 412 3390
suvakfi@suvakfi.org.tr - www.suvakfi.org.tr

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Extreme events, such as droughts and floods are related to climate variability and change. The climate change causes some areas to suffer more frequent and severe droughts, while other places to have more frequent and severe flooding. These changes virtually reflect their impacts on freshwater resources. The impact of drought on groundwater resources is obvious, but the impact of flooding may be less so. One impact of flooding is a significantly increased risk of groundwater contamination.

Hydrologists and climatologists have long been aware of the role of regional climate in the prediction of floods or in understanding drought. With our growing sense of a variable climate, it is appropriate to reassess these concepts of flood and drought, not as isolated events, but as phenomena connected on a worldwide scale.

Floods and droughts are not aberrations. Floods are initially more conspicuous than droughts because they can occur over days or weeks instead of months or years. Droughts require a more persistent weather pattern before they are recognized. We commonly assume that they are end members of the spectrum of possible meteorological conditions for a given locality. Another emerging perspective, however, is that floods and droughts arise from conditions that are somehow different than the established norm. Climate may not turn out to be a smooth continuum of meteorological possibilities after all, but rather the summation of multiple processes operating both regionally and globally on differing time scales. Floods and droughts are neither random nor cyclic. The extremes of flood and drought occur within the context of climate, a context that is both local and global. One must understand the geography and meteorological response of a given watershed to understand its history of flooding. One should also look beyond basin boundaries to appreciate the coherent patterns that influence weather regionally.

There is the likelihood of abrupt changes in the climate system such as the collapse of the ocean thermohaline circulation, inception of a decades-long mega-drought, or rapid melting of the major ice sheets.

Floods

A flood is an overflowing of water from rivers onto land not usually submerged. They also occur when water levels of lakes, ponds, reservoirs, aquifers and estuaries exceed some critical value and inundate the adjacent land, or when the sea surges on coastal lands much above the average sea level. Nevertheless, floods are a natural phenomenon important to the life cycle of many biotas,

not the least of which is mankind. Floods are the most destructive of natural disasters and cause the greatest number of deaths.

Catastrophic floods can explode suddenly out of a single summer thunderstorm. Flooding, however, can also be caused by a months-long build-up of moisture, such as the fast melting of a heavy winter's accumulation of mountain snow or soil saturated by high seasonal rainfall. All floods, of course, are shaped by the basin through which they flow.

Spatial and temporal scales of floods are generally linked to the corresponding scales of the flood generating rainfall coupled with weather and climate change conditions.

Many measures can be used by societies to cope with floods. They are usually classified into two major groups as engineering structural and non-structural measures. Furthermore, these measures can be combined together in order to maximize the effects of the alleviation of the floods risks.

Structural measures of the flood management can be defined as the measure that alters the physical characteristics of the floods. They usually involve engineering hydraulic structures as dams, reservoirs and retarding basins, channel and catchments modifications, levee-banks, flood proofing, etc.

On the other hand, non-structural measures alter the exposure of lives and properties to flooding (flood forecasting and warning, flood insurance, planning controls, public information and education, etc.)

It is worthy to remember that floods, after all, are periodical events, so that in between these events people forget their effects. For this reason it is important to increase awareness to the public of this problem. Increasing possibility of future climate change effects make this point more significant than before.

The alternating sequence of wet and dry years is difficult to comprehend, let alone predict. A tantalizing pattern links drought and its inverse, flooding, in many places around the world. Floods in one location and drought in another, so obviously different, often exist within similar global configurations of climate.

Floods do not just happen because of rains only. Floods happen because rain falls on saturated ground, because warm rain falls on an existing snow-pack, because rain falls heavily throughout an entire basin, or because the basin has been changed (either naturally or otherwise) so as to retain or heighten floodwaters that would have otherwise rolled on through without making a mess. Floods are usually more localized than droughts, both temporally and spatially because they require these specific pre-existing hydrologic and meteorological conditions.

Spring melting of winter snow is always a time of high river flow. In many regions, river channels shape themselves to accommodate these annual events, building banks and gradually raising floodplain terraces in response to each year's high water. Melt waters will usually be released from the snow-bound mountains in an orderly progression as springtime temperatures begin to rise. Floods will occur if temperatures rise faster than expected or if rain falls on snow that is already near its melting point. Destructive flooding does not always have to follow high precipitation.

Floods are fickle, requiring very specific conditions beyond merely humid weather. A flood might hit one basin yet inexplicably ignore another basin nearby. Whether widespread or local in scale, floods are set up by large-scale atmospheric processes recently including possible climate change effects. Whether the flood occurs or not when those

conditions are present is another matter that befuddles flood forecasters.

By 2025, one-third of the population of the developing world is expected to face severe water shortages. Yet, even in many water-scarce regions, large amounts of water annually flood out to the sea. Some of this floodwater is committed flow to flush salt and other harmful products out of the system and maintain the ecological aspects of estuaries and coastal areas (Seckler, et al., 1998).

Droughts

Droughts are manifestations of climatic fluctuations associated with large scale anomalies in the planetary circulation of the atmosphere. They imply precipitation absence or weak precipitation occurrence during a long time over large areas. It is very difficult to identify and to clearly determine the onset as well as termination point. It is a creeping phenomenon and its effects accumulate slowly and tend to persist over longer periods of time. The local and regional climate features are important in drought generation. This subsidence originates an adiabatic compression which leads to an increase of temperature and therefore to a reduction of the relative humidity. The subsidence further produces an inversion of temperature, which increases the static stability of the atmosphere and so prevents the formation of sufficiently thick clouds to generate precipitation. Since at the start the air is already dry, the relative humidity decreases further as the air mass subsides. The formation of clouds becomes difficult or if formed they dissipate fast by evaporation of cloud drops or crystals in the dry environment.

People start to feel drought when there is not enough water. When drought comes everybody is concerned, if it lasts everybody tries to do his/her best for the combat, but when it passes away everybody forgets except those who have been hurt (Yevjevich, et al., 1983).

In spite of all the inconveniences that drought cause, it is not yet sufficiently understood in terms of characterization and impact assessment. There is no general accepted definition of drought. Current definitions are based on different disciplines such as meteorology, hydrology, agriculture, geography, water resources development, water supply, industry, navigation, recreation, etc. From social and economic points of view the definition of drought should consider not only water supply but also water demand. Hence, drought depends on the water use practices and the population. Drought appears when there is significant temporal or spatial water shortage in an area. Droughts are basically economic and social phenomena.

Drought occurrences result mainly from variations inherent to atmospheric circulation. It may depend also on such factors as the transport of volcanic ash and dust, which reduce the solar radiation reaching the earth's surface.

Drought is more than a simple lack of rainfall. Drought is a persistent moisture deficiency below long-term average conditions that, on average, balance precipitation and evapotranspiration in a given area. Not all droughts are created equally. Similar moisture deficits may have very different consequences depending on the time of year at which they occur, pre-existing soil moisture content, and other climatic factors such as temperature, wind, and relative humidity. Drought can be defined in terms that go beyond the meteorologist's rainfall measurements.

Hydrologic drought occurs when surface water supplies steadily diminish during a dry spell. If dry conditions continue, ground-

water levels could begin to drop. Various drought characteristics such as duration, magnitude, and intensity are related to each other in a region (Sirdas and Şen, 2003).

Agricultural drought occurs when a moisture shortage lasts long enough and hits hard enough to negatively impact cultivated crops. Soil conditions, groundwater levels, and specific characteristics of plants also come into play in this functional definition of drought.

Ecologic drought is detrimental to native plants that do not have the benefit of irrigation. Drought depends on the persistence of dryness over months or years.

The crop yield in a year can be compared with its long-term average and drought intensity can be classified linguistically in a fuzzy manner as nil, mild, moderate, severe, or disastrous, based on the difference between the current yield and the average yield. Various researchers in different parts of the world have developed drought indices that can also be included along with the weather and climate variables to estimate crop yield. For example, Boken and Shaykewich (2002) modified Wester Canada Wheat Yield Model (Walker, 1989) drought index using daily temperature and precipitation data and Advanced Very High Resolution Radiometer (AVHRR) satellite data. The modified model improved the predictive power of the wheat yield model significantly. The performance of the regression techniques have been found to have improved significantly by including satellite data based variables.

Climate data during a growing season cannot be used for obtaining the long-term estimates simply because the long-term estimates are required prior to even sowing of the crop. As the yield is known to be influenced most by weather and climate conditions during the growing season, it is a common practice to estimate yield using climate data. Attempts to obtain long-term estimates that do not employ climate data are limited (Şen and Boken, 2005).

Aridity is a permanent climatic feature. Drought is an extreme event of a time and area process. In driest zones, the variability of precipitation is the highest.

Economic consequences of droughts are more important for humid regions because of unpreparedness of people to recurrent drought events and the large investments in agriculture may undergo large losses from droughts. Economic losses caused by droughts are mainly the reduction in the production of crops, cattle, industrial goods, poor navigation and hydro-power. Among the secondary effects of droughts are soil erosion and consequent dust storms, forest fires, plant diseases, insect plagues, decrease of personal and public hygiene, increased concentration of pollutants, degradation of water quality, harmful effects on wildlife, and deterioration in the quality of visual landscape.

In contrast to floods, droughts start in a comparatively sudden manner, have a relatively short duration and are restricted to local influences. While floods, earthquakes and cyclones are disasters associated with extreme high events, drought is the result of the low extreme as non occurrence of sufficient water. They seldom cause dramatic losses of human life except through famine.

Temporary of permanent migration have been a common form of social adjustment to droughts through history.

One of the dramatic long-term impacts of droughts, combined with the human activities, is the degeneration of productive ecosystems into desert in the process called desertification. Desertification is not exclusively as a consequence of drought, but it may be accelerated by droughts through phenomena as wind action in dry years, soil

erosion in drought and post drought periods, and particularly through human activities that are responsible for poor management of land, soil, crops and herds. The desertification areas reflect more of the solar radiation than the original land by causing changes in thermal regime of the atmosphere that in turn may tend to extend or intensify droughts.

Throughout the history drought has been the companion of humanity. Over years drought impacts have been felt in agriculture, water supply. Industry, pollution control, energy, recreation and a host of other activities related to water and society.

Drought impacts

Droughts have socio-political, economic and environmental impacts which are interrelated with each other. Drought effects are intricately related to the environmental economic and social fabric of a given region or an entire nation. Its consequences are population shifts and/or reduction, alteration of the social structure, large economic hardship and significant environmental perturbations. In order to better understand the drought concept the following four different events must be considered.

1) Aridity: It is a permanent natural condition and a stable climatic feature of a region.

2) Drought: It refers to a temporary feature of the climate or to regular of unpredictable climatic changes.

3) Water Shortage: It is understood mostly as a man-made phenomenon reflecting the concern with temporary and small area water deficiencies, and

4) Desertification: It is a part of an alteration process in the ecological regime often associated with aridity and/or drought but principally brought about by human-made activities which change the surrounding environment to a significant degree.

Droughts represent temporary imbalance in the irradiative transfer with characteristics that it is persistent lower than average precipitation with uncertain frequency, duration and severity; has unpredictable consequences; represents overall diminished water resources, and has diminished average carrying capacity of ecosystem.

Among the drought effects are deterioration of farm and rangelands, increase wind erosion, reduction in natural flora and fauna, air quality deterioration, brush and pest infestations, and strained water supply.

Responses to droughts necessitate resource use regulation, rationing and/or recycling, institutional measures. Possible social consequences of droughts may be bulleted as follows.

1) Agricultural: Loss of income, increased indebtedness, bankruptcy, and dislocation.

2) Regional: Regional instability, migration intensity increase, unemployment increase, and regional economic sector disruptions.

3) National: Increased government payments to agricultural sector, foreign trade losses, rising prices, health effects and food shortage, and

4) Worldwide: Severe health effects, disruptions in world social order, international conflicts, starvation, and famine.

The biosphere may respond fast, e.g. to droughts, but also very slowly to imposed changes, such as the climate change.

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SU VAKFI

Libadiye Cad. Doğanay Sokak No:6 Kat:4 Üsküdar İstanbul
Tel: (216) 412 3383 - Faks: (216) 412 3390
suvakfi@suvakfi.org.tr - www.suvakfi.org.tr