

FLOODS AND DROUGHTS.

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INTRODUCTION: -

Water is an essential resource for survival of life, however excess of it can cause calamity and lack of it can cause disaster. Excess of water than required can cause flood and on the other hand water deficit can cause drought. Flood and drought are extreme negative situations caused due to water imbalances. These disasters though mainly natural have substantial human intervention triggering the impact. Flood and drought have occurred in the past as well, but its frequency has increased in the recent years due to changing climatic pattern. Floods and Droughts have huge impact on earth and lives and deaths of living communities.

Flood Situation



Drought Condition



Natural disasters including floods and droughts can strike any part of the world but evidences show their impact is disastrous in developing countries than the developed one's, mainly due to the availability of their advanced warning system and proper disaster management system. For instance, as per report from ((Centre for Research on the Epidemiology of Disasters (CRED, 2004)), USA has faced maximum number of disaster events including typhoons and floods (506 reported events) between 1974-2003, with 4.5 million victims, whereas India experienced 303 disaster events during the same period but the number of victims was much higher approx. 1932 million people.

FLOOD:- happens when water quantity of any region exceed the normal requirement level damaging the physical, infrastructural, economic and social set up of the affected area. Heavy rainfall mainly causes flood in an area when the natural watercourse fails to channelize the excess water. When the banks of the river fail to contain the heavy flow of water due to heavy rainfall, inundation occurs; even high storms during tsunamis or cyclones can cause inundation near coastal areas. Places without proper drainage system also get flooded during heavy rainfall.

DROUGHT:- is also an extreme situation, which happens due to insufficiency of precipitation over a longer period causing damages to crops. Definition of drought varies in different countries and regions depending on the average precipitation level of the country such as countries or regions generally receiving lesser annual average rainfall don't consider 5 to 6 days without rainfall as drought however similar condition is called a drought situation in countries receiving higher rainfall throughout the year.

CAUSES OF FLOOD:-

Flood can cause due to any of the following or combination of the following reasons:



EXCESSIVE PRECIPITATION: Heavy precipitation or rainfall in an area than normal along with poor drainage system can cause flood like situation. Flood can occur in both cases of heavy rainfall for shorter duration and continuous light rainfall for many days.

RIVER RUNOFF: Excessive supply of water in the upstream due to heavy rainfall or otherwise can cause the downstream river water to run into the land or flood plain areas causing inundation.

STRONG COASTAL WIND OR CYCLONE OR TSUNAMI: Strong coastal winds have the capacity to carry water from the sea to the land causing inundation in the coastal areas. Besides, Cyclones and strong winds can also bring heavy rainfall, causing flood on inland areas as well.

BREAKAGE OF DAMS OR EMBANKMENTS: Embankments or levees are built alongside the river to prevent overflowing of water or avoid flood like situation on the adjoining land. However, breakage or leakage on the embankment can lead to overflowing of river water on the flood plain also heavy water flow can break embankment and cause flood. Similarly, dams, which are built to capture water flowing down from upland can cause floods if broken due to excessive pressure of the stored water, even at times extra water from dams are knowingly released to avoid possible breakage or leakages, which can also cause flood like situation in the lower lands.

BREAKDOWN OF ICE DAM: Ice dams occurs when glaciers or ice blocks restrict flow of river water during freezing weather. This stored water behind ice sheets/ blocks or proglacial lakes when released due to ice melting is more powerful than normal river water flow and can cause inundation at the lower catchment areas. e.g The Flood in Russel Fjord in Alaska USA in 1986 caused due to breakage of Ice dam.

VOLCANIC ERUPTIONS: Volcanic eruptions has caused floods in country like Iceland where volcanic vent covered by thick layer of ice/ glacier got melted due to emission of hot lava. The melting glaciers turns into fast flowing water down the steep volcanoes causing inundation in the nearby areas.

TYPES OF FLOODS

FLASH FLOODS: Flash Flood appears very fast and due to its sudden arrival, the term flash has been added to this types of flood. Flash flood cover smaller area but with high intensity, usually due to heavy rainfall or breakdown of Ice dams. Because of its higher speed and sudden appearance this flood causes more damages and is dangerous. Flash flood can even transport heavy rock,



boulders and other heavy items due to its high speed. Besides, its capacity to carry debris makes this flood more dangerous as it can damage both life and property.

SLOW ON-SET FLOOD: This type of flood lasts long and spreads over larger areas and occurs mainly due to overflowing of rivers or other water bodies. Since many coastal areas and flood plains repeatedly get inundated during rainy seasons, people for safety move up to higher grounds during this period. The after effect of this flood is more dangerous as people die due to diseases and famine.



RAPID ON SET FLOOD: This type of flood occurs fast and last for a shorter period almost for a day or two. This flood is associated with heavy rainfall and as it appears fast the chances of damages to property and life are high as people get less time to prepare before the flood appears.



THE OTHER TYPES OF FLOODS ARE:

ICE DAMMED FLOOD: Ice Dam Flooding happens when flowing water, which were initially restricted by block of ice flow again due to melting of ice or spilling over of the piled up water above the ice wall into the nearby plain areas. This flowing water is more powerful and dangerous than simple flowing river as this water carry big pieces of ice and thus with flooding of the plain area, this ice loaded water can damage property and life.

COASTAL FLOODS: This is a common type of flood in coastal areas. This flood is caused by high storms and waves in the oceans and mainly the area near the ocean edges get inundated. Even Tsunamis, cyclones, hurricanes and tornadoes with low pressure center, which pulls the water from the ocean towards the center of the storm carries the dome of water while moving towards the land and when reaches the coast this water loaded storm causes flooding and resultant damages. Even fast moving waves or storms are destructive at times breaks past beaches and causes flooding at the coastline.

STORM SURGE FLOOD: This is more devastating than the coastal flood as the storm rises above normal high tides mainly due to strong winds and lower atmospheric pressure. Storm surge the causes huge damages to large areas near the coasts. These storm surges up to a height of 20 feet or more. Major hurricanes with huge storms have caused damages to property and life in the past including the recent past, where hurricane Katrina caused huge damages along the gulf coast in Texas and state of Florida.

BREAKAGE OF WEAKLY CONSTRUCTED DAMS: Over filling up of dams can break the walls of the dam when weakly constructed and cause flash floods in the downstream regions.

PROBLEMS OF FLOODING:-

THE ECONOMIC IMPACT OF FLOODING: Floods like flash flood, storm surge causes huge damages to properties and infrastructure of the affected areas. Houses, bridges, farms, roads, electric poles and vehicles are mostly destroyed causing huge economic losses to both public and government. Many people losses their livelihood due to floods impact on agricultural fields, industries etc. Due to damages in communication lines, infrastructure and transport networks business takes hit not only in the flood affected areas but also in the adjoining localities. The long time after effects of flood are felt in terms of lack of clean drinking water, disruption in power supply, reduction in purchasing power of people due to loss of income, rise in prices of basic items etc. Even rebuilding the infrastructure, rehabilitation of people and bringing the normalcy in economic activities takes lot of time causing further economic losses. For instance, the flood in Chennai, India in November 2015 is estimated to have caused \$3billion losses. As per estimation by NOAA the flooding in 2011 in USA caused a loss of about \$ 8.41 billion. Besides if floods occurrence is regular many people and business moves out of the place leading to mass migration, development in these places cripples as government and private business fear of similar devastations in future due to recurring nature of flood. The following table shows the impact of flooding on India's GDP.

ENVIRONMENT IMPACT OF FLOODING: Flooding has its impact (both negative and positive) on the environment. Unlike the economic impact of flooding, which is mainly negative, flooding has some positive impact on environment. Such as refueling of surface and ground water storage. This replenishment of water supply helps in improving the soil quality and thus crop production. But the negative impact of flooding on the environment is quite dangerous as the flood water brings along with it different types of pollutants, chemicals, debris including uprooted trees, stones etc. This polluted water contaminates the clean water due to breakdown of water pipes and drainage systems. Besides, due to flooding many animals loses their natural habitats and contaminated water impacts the health of livestock as well as wild animals. Reduction in biodiversity level happens due to death and displacement of many animals during and after flood. As noticed in Australia's Queensland in 2011, where heavy flooding resulted in death of many animals. The flood water once receded leave behind debris and sediments, which also hampers the water quality.

In 2011, Tsunami struck Japan and many coastal areas got flooded including the Fukushima, where waves caused level 7 meltdown of the power plant and release of radiations due to cooling system failure by Tsunami. Nuclear radiation release has long term negative impact on the health of people, animals and the environment.

IMPACT OF FLOODING ON HUMAN AND ANIMAL: The direct impact of flooding is experienced maximum by humans and animals. Flash flooding or sudden arrival of huge floods causes many damages to people and animal including loss of lives and properties. Many animals and people are forced to migrate to safer places. Post flooding rise in diseases also impacts human and animals badly. Many people become homeless due to flood havoc. In addition to the physical impacts people also suffers psychologically. The flood victims can remain traumatized for longer period of time as they see all the devastation in front of their eyes. Also, by losing home and other properties the security level of people decreases they become vulnerable to many threats. The

stress to rebuild the life post devastations takes further toll on human's life. The following table shows the loss of human and cattle life in India due to flood from 1953 to 2016.

DROUGHT: -

Increasing temperatures and changes in rainfall patterns are expected to increase the frequency and intensity of drought in many regions. When rainfall is less than normal for several weeks, months, or years, the flow of streams and rivers declines, water levels in lakes and reservoirs fall, and the depth to water in wells increases. If dry weather persists and water-supply problems develop, the dry period can become a drought. The term "drought" can have different meanings to different people, depending on how a water deficiency affects them.

Drought is described in terms of various statistics that summarize drought duration, intensity, and severity. Droughts are generally classified into four categories:-. **Meteorological drought** refers to a precipitation deficiency, possibly combined with increased potential evapotranspiration, extending over a large area and spanning an extensive period of time (Fig. 5 and 6). **Soil moisture drought** is a deficit of soil moisture (mostly in the root zone), reducing the supply of moisture to vegetation. Soil moisture drought is also called agricultural drought, because it is strongly linked to crop failure.

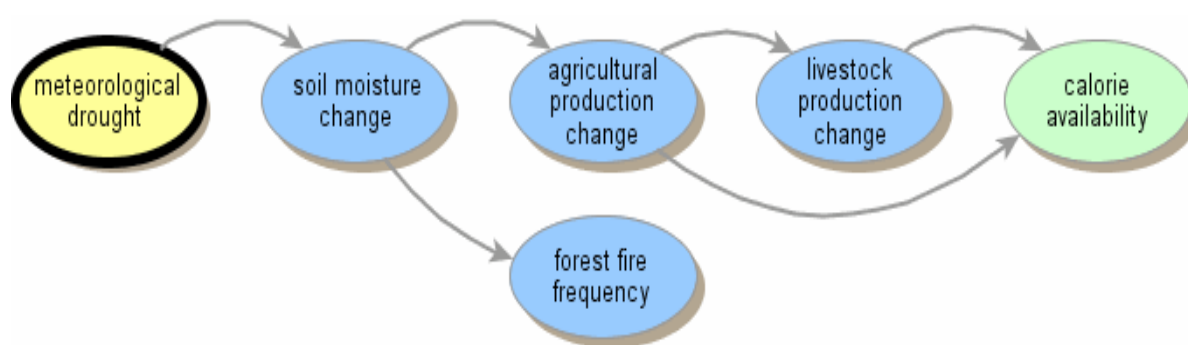


Fig. 5: Impacts of Meteorological Drought



Fig. 6: Drought Affected Land

HYDROLOGICAL DROUGHT is a broad term related to negative anomalies in surface and subsurface water. Examples are below-normal groundwater levels or water levels in lakes, declining wetland area, and decreased river discharge.

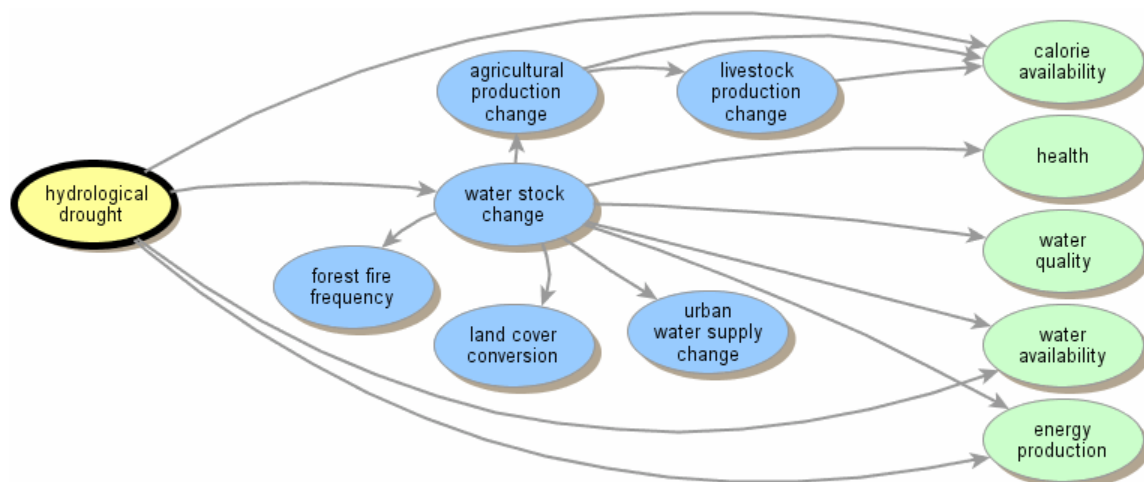


Fig 7: Impacts of Hydrological Drought

SOCIOECONOMIC DROUGHT is associated with the impacts of the three above-mentioned types. It can refer to a failure of water resources systems to meet water demands and to ecological or health-related impacts of drought. An overview of the most important drought impacts is provided in Table 1. It can be noted that more types of drought impacts are related to hydrological drought than to meteorological drought.

Figure 8 depicts the state of drought around the world in August 2015. The dark brown patches indicate areas of exceptional drought, through to patches of dark blue showing areas of exceptional wetness. Most of the African countries are worst affected by Drought.

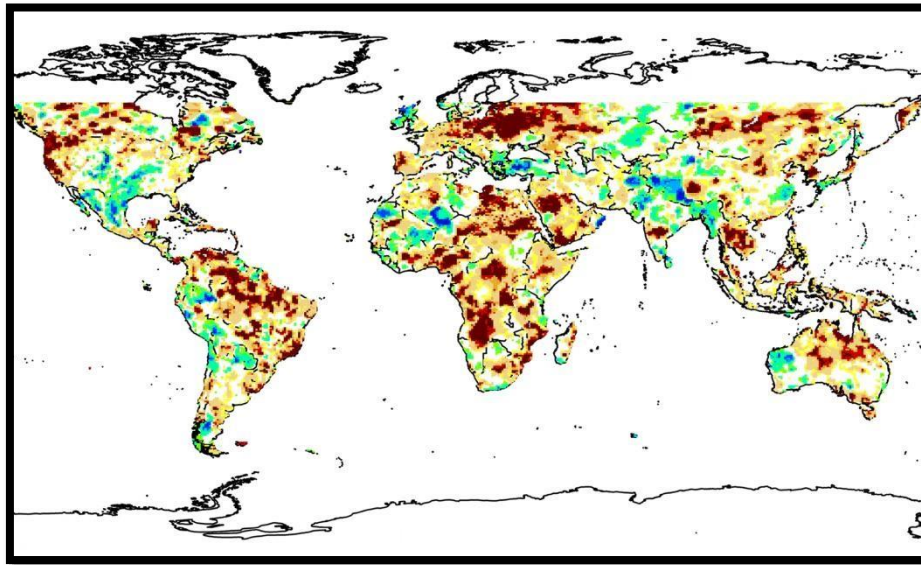


Fig. 8 Distribution of Drought around the World

A groundwater or hydrological drought typically refers to a period of decreased groundwater levels that varies regionally and locally based on due to differences in groundwater conditions and groundwater needs for humans and the environment. Reduced groundwater levels due to drought or increased pumping during drought can result in decreased water levels and flows in lakes, streams, and other water bodies. Decreased groundwater flow to surface waters can affect aquatic ecosystems that rely on a continuous supply of groundwater to sustain aquatic habitats and stream flow. The ground water has important role in keeping water balance on the earth. The fresh water found beneath the surface which is beyond the soil-root zone is known as ground water. It is the largest potential freshwater in the hydrological cycle. Ground water level in most of the countries decreasing due to overconsumption. Ground-water systems are a possible backup source of water during periods of drought.

It is not unusual for a given period of water deficiency to represent a more severe drought of one type than another type. For example, a prolonged dry period during the summer may substantially lower the yield of crops due to a shortage of soil moisture in the plant root zone but have little effect on groundwater storage replenished the previous spring on the other

hand, a prolonged dry period when maximum recharge normally occurs can lower ground-water levels to the point at which shallow wells go dry. If ground-water storage is large and the effects of existing ground-water development are minimal, droughts may have limited. In the absence of ground-water development and continuous Ground-water withdrawals may reduce the water flows in lakes, streams, and other water bodies can cause low water level. Likewise, reduced freshwater discharges to coastal areas during droughts may cause seawater inundation towards land beyond limits that may lead to renewed land subsidence. A common response to droughts is to drill more wells. Increased use of ground water lead to permanent, unanticipated change in the level of ground-water development. Ground-water systems tend to respond much more slowly to short-term variability in climate conditions than surface- water systems. As a result, assessments of ground-water resources and related model simulations commonly are based on average conditions, such as average annual recharge or average annual discharge to streams.

The effect of potential long-term changes in climate, including changes in average conditions and in climate variability, also merits consideration. Climate change could affect ground-water sustainability in several ways, including (1) changes in ground-water recharge resulting from changes in average precipitation and temperature or in the seasonal distribution of precipitation, (2) more severe and longer lasting droughts, (3) changes in evapotranspiration resulting from changes in vegetation, and (4) possible increased demands for ground water as a backup source of water supply. Climate can be a key, but underemphasized, factor in ensuring the sustainability and proper management of ground-water resources. Management and conservation of water resources are critical to human welfare. The high demands for water of an increasing world population have focused our attention on water resources quality and quantity management. Climate change is likely to have significant effects on hydrological regimes, affecting both water quantity and water quality. Drought is arguably the biggest single threat from climate change. Its impacts are global. Drought triggered crisis in many middle east and African countries. Relief failures and poor drought forecasting caused several deaths in Horn of Africa during 2011 and 2012. The consequence is an increasing demand on a decreasing availability of water resources. Hydrological drought is crucial for various hydrological studies such as water quality management, determination of minimum downstream flow requirement for hydropower and ecological needs, irrigation system design and wastewater treatment.

LACK OF PRECIPITATION: When the level of precipitation is less than about 75% of the normal average, over a long period of time, drought happens. The drought condition is more prevalent when agriculture.

DROUGHT AND ITS CAUSES :-

If flood happens due to excess of water than drought due to lack of it and dryness and resultant lack of agricultural production leads to drought situation. The major causes of drought are:

REDUCTION OF SURFACE WATER FLOW: - When the flow of surface water bodies like streams and rivers reduces or the rivers get dried up due to storage of water in dams/ reservoirs in the upstream for hydro power plants and irrigation facilities, drought like situation happen in the downstream regions of the river.

DEFORESTATION:- Hydrological cycle (including evaporation, precipitation and condensation) of the earth is maintained by plants and trees. Trees have water retention capabilities, can control evaporation and maintain ground water level. Deforestation due to excessive population growth and various economic activities has exposed the surface to erosion and reduced the level of ground water and the ability of the earth surface to hold water, as a result with prolong period of dryness, desertification and drought crises appears.

GLOBAL WARMING: - Rise in global temperature due to increase in greenhouse gases has impacted the climate drastically as a result many areas goes dry and forest catches fires leading to desertification and drought like condition.

TYPES OF DROUGHTS: -

Droughts conditions can be classified as agricultural, meteorological, hydrological and socio economical drought. The drought condition act as indicators for government agencies, authorities and municipalities to develop a relief plan and provide related assistance to effected public.

AGRICULTURAL DROUGHT: -

This drought condition impacts the country's economy drastically. Farmers are badly effected with agricultural drought when soil moisture decreases and water demand for crop production surpasses the water supply level impacting crop growth. Decline in crop growth and production ultimately hampers the food supply and economy. Agricultural drought condition happens when the soil moisture reduces due to hot and dry weather with less rainfall leading to lack of agricultural production.



HYDROLOGICAL DROUGHT:-

This is a drought condition where in the water level of all the surface water bodies including dams, lakes, reservoirs, rivers etc. falls below an established standard. Even when demand or usage of water is more than the supply or availability of water in the reserves hydrological drought happens.



METEOROLOGICAL DROUGHT: -

This drought condition is due to natural factors like lower level of precipitation, lack of moisture in the atmosphere, dryness for longer period and high temperature. Meteorological drought if persist for longer time period can cause serious water crises and related problems. This drought can stretch from a small period to longer period.



PROBLEMS OF DROUGHT: -

The impact of drought can be felt beyond the physical boundary of drought hit areas. As drought condition is associated with lack of water, it impacts not only the society but also the economy and the environment.

ECONOMIC IMPACT OF DROUGHT: -

Water is required for production of goods and service, thus lack of it impacts people, business and governments. Water is prime factor for agricultural and related field, crop production largely depends on the water supply, and hence shortage of it hampers production of both crops and livestock's. Farmer's or crop producers bear the brunt directly as lower crop production means direct loss of profit margin and income. Loss of income mainly of the farmer impacts their social life. Lower production and higher demand for food supply can lead to price rise of basic commodities, which have direct impact on the buyers especially the lower income group. Also, in case of shortages of basic commodities, things might be imported, again costing the government. Business might take a hitting if drought conditions persist for a long time such as most manufacturing industries, agricultural product industries, and water

recreational business depends on water, so lack of it can force the business to stop operation in the affected areas. Thus many people can become jobless.

Besides, drought condition and associated dryness also increases the chances of wind erosion and birth of various diseases and epidemics as well, which costs individuals, community and the nation at large.

Lower precipitation, high temperature and dryness increases the chances of forest fires, which damages the habitat for both animal and human. Forest fire and damages to plants and other vegetation impact both public and the government.

In addition, shortage of water or dryness of the surface water like rivers can impacts hydro power generation as well as transportation through waterways.

SOCIAL IMPACT: -

Drought has its direct impact on the people and the society and many indirect long term impact. For our basic daily activities including cooking, eating, bathing and cleaning we need water, thus its shortage or lack of it can directly impact our lives.

Water is directly related to our health as well, we need clean and fresh water for drinking and cooking. Polluted and stale water can cause serious health implications and spread diseases across the society.

Due to lack of water supply agricultural and live stocks production takes a hitting causing lack of

food production. When the supply is low the price rises impacting the poor people of the society most. Without proper watering of plants, the quality of food also reduces and so does the nutritional values of the food. This lower quality food supply affects health of both human and animal and makes them vulnerable to diseases and health issues.

If drought conditions persist people prefer to migrate to other places leaving their property and at times their families. Many farmers in case of agricultural droughts have to leave their farms and take up odd jobs in other areas or towns.

Water, its supply and shortages have triggered many disputes between nations, states and neighboring people. For instance, in India disputes between states regarding water is not very uncommon like Kaveri river water dispute between Karnataka and Tamil Nadu, Yamuna water usage issues between Delhi, UP and Haryana etc. these disputes causes social unrest.

ENVIRONMENTAL IMPACT: -

Drought like conditions impact the environment drastically. If the rivers, streams and other water bodies do not get fresh water supply through precipitation or melting snow the ecosystem of such aquatic bodies can be drastically impacted. Many water borne organisms and animals dies due to lack of water supply. Lakes, Ponds and rivers, which get replenished with fresh rain water might also die if shortage of precipitations last for longer period. Soil erosion due to high temperature and dryness can remove the productive top soil leading to lower biological production and land degradations. Many animals and organisms loses their habitat threatening their extinctions.

DROUGHT MITIGATION AND MANAGEMENT: -

Drought is a natural hazard that cannot be stopped from occurrence but its affects can be minimized with proper planning. Drought conditions takes time to evolve hence precautionary measures can be taken to minimize the risk of drought devastations. Predictions, observations, impact analysis and reaction are four major components of drought preparedness. Predictions about the impending climatic conditions and precipitations based on remote sensing data, satellite imageries, wind circulations etc. and proper monitoring of cloud movements, water availability and conditions of the crop are necessary steps of drought preparedness. Impact analysis of drought includes the study of crop quality, human health, state's economy and ecosystem. The response of drought includes providing relief to effected people, water storage facilities to all, water and soil conservation, more vegetation and proper planning. Following are some of the major steps to prevent drought like conditions:

EDUCATION AND AWARENESS: -

People should be educated and informed about the causes and impacts of drought in advance. Community leaders, NGO's, schools, Colleges, government officials etc. should be trained to educate general public about ill effects of drought and steps to mitigate it. Knowledge about the problem can help the public to create their own solutions. People in the governing authority should also gain knowledge about the climatic conditions and regional landscapes so that natural disasters like drought does not take them by surprise and policies can be defined well in advance to tackle any such unwanted situation.

POLLUTION CONTROL: -

In case of shortage of natural water supply through precipitation and meteorological drought conditions people depend on the available water resources such as rivers, lakes, ponds etc. for clean usable water. However, if these surface water or ground water resources are polluted then problem escalates. Hence, government should ensure that the surface and ground water sources are not polluted. Even people should be educated about the problems of drought and the need for maintenance of clean water and control of pollution.

WATER AND SOIL CONSERVATION: -

Water conservation and soil conservation measures can help in limiting the devastating impacts of drought. Water conservation methods such as rainwater harvesting, surface runoff water collection, percolation ponds, proper planning of water usages, dams and reservoir construction and proper management of well and water channels limits the impact of meteorological drought conditions. Similarly, through soil conservation methods soil moisture can be retained and soil erosion can also be controlled during drought period. Methods such as crop rotation, terrace farming, etc. control soil erosion and soil moisture can be retained by measures such as furrows, basins, ridges, catch pits etc., even landscape contouring where the runoff water can be directly spread in planted areas helps in increasing the soil moisture content.
