FLOODS AND DROUGHTS IN INDIA: CAUSES AND SOLUTIONS

Chetan Pandit

Floods can't be entirely prevented. The approach to flood management is a combination of protection from floods of less severity; reducing the damage by flood forecasting; and disaster relief in case of floods of larger severity. Flood management options are typically divided in two types, structural- i.e. comprising some construction, of embankments, and flood control reservoirs; and non-structural, comprising flood forecasting, flood plain zoning, and disaster relief.

On an average, every year India gets 4,000 billion cubic meters of water mostly through rainfall and some snowfall. However, this is the average, over a large number of years. In any given year, the rainfall, and hence the river flow, may vary from this average, on the lower side, or on the higher side. Such rainfall instances, very low or very high, are called hydrologic extremes. Floods and droughts, both are a result of hydrologic extremes. This short article explains the phenomenon of floods, and droughts, why these occur, and how to manage them.

Floods:

The term 'flood' is commonly used to describe any inundation by water. But there are two distinct mechanisms that can cause inundation. A rainfall takes place somewhere in the upstream catchment, and consequent high flow in the river may spill out in to the habitation areas some where downstream. This is called flood. The other mechanism is, a high rainfall may take place locally, and the rainwater may fail to drain out fast enough, and accumulate in the city/ village. This is called drainage congestion. The inundation that takes place in many parts of Uttar Pradesh, Bihar, and Assam every year, is flood. The inundation that took place in Mumbai in July 2005, or September 2017, was drainage congestion.

In India, 33.5 m.Ha (million Hectares) of area is flood prone, and out of this, on an average, some or 7.5 m.Ha is affected by floods every year. The floods are most common in Ganga and Brahmaputra river basins.

Causes of Floods:

- A very heavy Rainfall in the upstream catchment causes a very large river flow. The width of the river through the city downstream is not adequate to carry that flow, and the water spills over, beyond the usual river banks.
- Natural Lake Burst. A landslide takes place in

the river and acts like a dam. Water accumulates behind it, creating a lake. As the water storage builds up, the landslide-dam blocking the path of water bursts, and the accumulated water flows out in a short time, causing a flood.

- **Breach of Embankments.** Embankments are constructed along both banks of the river to protect human habitation. If the embankment breaches, the river flow enters the habitation.
- **Dam Break.** This is very rare, but a man made dam may burst releasing a large quantity of water and causing a flood.

Whatever may be the cause, a flood causes a huge damage to property and also life – human and farm animals, destroys standing crops, deposits sand in the farms and renders them unsuitable for cultivation, destroys buildings and also destroys roads/ railway lines/ bridges/ communication links. A flood also destroys drinking water sources and is often followed by an outbreak of water borne diseases.

Managing Floods:

Floods can't be entirely prevented. The approach to flood management is a combination of protection from floods of less severity, reducing the damage by flood forecasting and disaster relief in case of floods of larger severity. Flood management options are typically divided in two types, structural- i.e. comprising some construction of embankments, and flood control reservoirs; and non-structural, comprising flood forecasting, flood plain zoning, and disaster relief.

Embankments are low bunds constructed along the river bank, to "contain" the river flow and prevent it from spilling in to the areas of human activity. Embankments are the fastest way of providing protection from a flood of specified severity, and can be constructed within one year. However, embankments need careful maintenance else these can breach. Also, embankments can increase the flood problem upstream and downstream.

A flood control reservoir stores the incoming flood water, and releases it slowly after the flood is over. Flood control reservoirs are the most reliable and long lasting protection from floods. Many such reservoirs have been constructed in India and have very successfully provided long term flood protection. Most famous examples being Hirakud dam on Mahanadi, and a series of dams in Damodar valley.

Flood forecasting doesn't prevent flood, but can prevent loss of life, and to some extent the loss of property. Flood plain zoning refers to restricting various activities in flood planes, depending on the risk assessment. Viz. an office may be built close to the river, where the flood risk is high, but hospital or school must be built farther away, where the risk is less.

Finally, if a flood does occur, relief operations are needed to rescue marooned people and provide them with shelter, food and water, and medical help.

Drainage Congestion:

Inundation in cities is usually due to the inability to drain out the rain water fast enough. Construction of buildings impedes the flow of water over the land; solid waste may choke the storm water drains, which are in any case not adequate, and in coastal cities, the problem is compounded if a heavy rainfall coincides with high tide. Mumbai was inundated on 29th August 2017. And at the same time, the city of Houston in USA was also inundated, far worse than Mumbai, due to the same mechanism. It may sound harsh, but short duration inundation due to drainage congestion, is a problem the cities may have to live with.

What is Not A Solution:

We live in an era of self-proclaimed experts, and there is lot of misinformation doing the rounds, about what causes floods and how to manage them. Three of these needs to be addressed.

- Dams do not cause floods. Dams moderate floods. The extent of moderation depends on how full the reservoir was when the flood started. But the flood released over the dam spillway is invariably less than the flood that would have been, had there been no dam.
- Forests are not the solution to floods. Foliage of trees intercepts some rainfall; tree roots promote percolation; and trees act as impediment to water flow. But the impact of all this is perceptible only for small floods. For large devastating floods, the impact is insignificant.
- There is no such thing as 'our ancestors had learnt to live with the floods'. When the population was less, and the pressure on land resources was less, it was possible to simply live away from the river. Many villages are now located close to the river out of compulsion.

Droughts:

Like floods, droughts are also a hydrologic extreme. But drought neither have a clearly defined beginning, nor a clearly defined end. At times, it may not be even possible to say with certainty that a drought has set in. Drought is a phenomenon that extends over a long duration. Droughts are divided in three types.

- **Meteorological** drought is when the rainfall is deficient.
- **Hydrological** drought is when there is inadequate water in the rivers and /or aquifers.
- **Agricultural** drought is when there is inadequate water supply to crops, and the crops start wilting.

About 153 mha area of the country is drought prone. Till about 1900, drought meant famine and widespread deaths. As many as 11 famines were recorded between 1769 and 1901 with an estimated 20 million deaths. However, now it is possible to transport large quantities of food grains to drought affected area, and to some extent also transport water, and the famine deaths are avoided. Nevertheless, drought brings severe distress to rural people even in this age.

When the rainfall is severely deficient, a normal crop can not be achieved. The objective should be to enable survival of the people and farm animals, till the next monsoons. Ground water can provide the minimum quantity of water required for such survival, provided it is wisely used when there is no drought. Unfortunately, that does not happen.

Ground water can be viewed as comprising two components. One, the annual recharge. Two, the water that has come to be stored in deeper aquifers, over a very large number of years. The ground water strategy should be to use every year only that water which is recharged every year, and keep the water in deeper aquifers as a reserve, for supplying minimum requirement during a drought year. This strategy will not completely avoid a drought, but will considerably reduce its impact. Unfortunately, there is no control on extraction of ground water, and not only the annual recharge but even the deeper aquifers are being pumped dry.

Inter Basin Water Transfer (IBWT):

The geographical area from which the rainfall accumulates and drains out through a river, is called its river basin. By an ingenious design of canals, and at times by pumping, it is possible to take water from a surplus basin to a deficit basin. Such water transfer is called inter basin transfer of water. The earliest plan to construct canals to link certain rivers, was in the year 1858 by Sir Arthur Cotton, a British engineer. However, the purpose of his plan was inland water transport, and not water distribution. Around the same time, railway as a means of transport became feasible, and his plan of interconnecting the rivers was set aside.

Around 1972, Dr. K L Rao, a former Minister for Irrigation, and also an accomplished river engineer, proposed a plan to transfer water from Ganga near Patna to Cauvery through a series of canals and pipelines. His plan was based on good engineering, but the cost was very high as compared to its benefits, and therefore, it was not taken up for construction.

In mid 1970s, Capt. Dinshaw J Dastur proposed another scheme comprising two very large canals, a 4200 km long canal in Himalayan area, and a 9300 km long canal in peninsular India, and two pipelines connecting these two canals, to connect some major rivers. Dastur's plan was well intentioned, its engineering concept was unsound. The 4200 and 9300 km long canals he envisaged were impossible to construct, so the question of cost or benefit did not arise.

In 1982, the Government of India set up National Water Development Agency (NWDA) to carry out the water surplus/ deficit studies for major river basins, and prepare a plan for inter basin water transfer. After about 18 years of work, around the year 2000, the NWDA made public the "National Perspective Plan for Inter Basin Water Transfer", (NPP) popularly known as river linking plan.

NWDA discarded the earlier ideas of one huge canal to link all the rivers, identified water surplus areas and water deficit areas, and proposed 30 different links to transfer water from surplus areas to deficit areas. This is the plan that the nation is now pursuing. For more details of this plan, the reader may visit the website of NWDA, www.nwda.gov.in. Following are the benefits of NPP:

- Irrigation to an additional area of 35 mHa;
- Generate 34,000 MW of hydro power;
- Provide drinking water to a large number of villages and towns;
- drought mitigation in Andhra Pradesh, Karnataka, Tamil Nadu, M.P., W.B., Bihar, U.P., Haryana, Rajasthan, Jharkhand, and Gujarat;
- Flood control in Ganga, Brahmaputra, Mahanadi and Godavari basins;
- Facilitate inland navigation;
- Development of fisheries;
- Infrastructure Development;
- Employment Generation;
- Improve aquatic environment by improving EFR, during lean season.

It needs to be pointed out that IBWT will provide flood control, not by transfer of excess water outside flood prone area, but by construction of many reservoirs, which are an integral part of the NPP. The reservoirs will reduce the flood peaks by 20 per cent to 30 per cent, but will not eliminate the flood problem entirely.

The main objective of the IBWT is to reduce regional imbalance in water availability. A stage has come where some areas have water but no land to irrigate, and some areas have land but no water. IBWT is not something new, or out-of-this-world idea. Many such schemes are already existing. The most notable are, Beas – Sutlej link, IGNP Canal which brings Sutlej water to Rajasthan, Sardar Sarovar main canal that takes Narmada water to Saurashtra, Periyar Vaigai link, etc.

Unfortunately, in India, any infrastructure project is opposed in the name of environment and rights. And the NPP for IBWT is also being opposed. In February 2012, the Hon'ble Supreme Court gave detailed directions for implementation of NPP. Some activists filed a review petition, but this was rejected by the Court. However, the environmental laws and procedures in India are very strict, and land acquisition is also a problem. Ken-Betwa is likely to be the first link to be taken up, and one hopes that more will follow soon.

(The author is (Retd) Member, Central Water Commission. Email: cmpandit@gmail.com)