Drought in South Asia: Some lessons

Severe drought across South Asia has sent a signal that drought prediction methods and combating measures developed over the last two centuries are inadequate to address the problem, writes M. Monirul Qader Mirza

IN the current year a drought engulfed a vast area in South Asia stretched from south-western India to Afghanistan. This is considered as one of the worst droughts in the last 100 years that has left a trail of destruction in Gujrat, Rajasthan, Andhdra Pradesh, Madhaya Pradesh, Himachal Pradesh, Manipur and Mizoram in India, Balochistan and Sindh in Pakistan and in a large part of southern Afghanistan.

In India, nearly 100 million people, one-tenth of the total population, has been affected by drought In Gujrat. Fodder crop failure has affected slightly over seven million cattle in Gujrat and nearly 35 million in Rajasthan. Reduction in food grain production has been estimated to be in the range of 25-30 per cent. Oilseeds production is expected to be lower by 50 and 17 per cent in Gujrat and Rajasthan respectively. In other states, damage caused by drought is not at the level of these two states, but significant.

In Pakistan, Balochistan and Sindh are the severely affected provinces. Thar district in Sindh has been ravaged by the worst water shortage in 100 years that forced thousands of people to flee from their villages. Daily maximum temperature has been fluctuating around 49 degrees Celsius in Sindh and Balochistan. An estimated 10 million people are said to have been affected by drought. According to the international relief agency OXFAM, some areas in Balochistan and Sindh are not far from facing a disaster on the scale of the recent famine in Ethiopia unless proper interventions are made. Drought has affected more than 90 per cent of the agriculture and livestock population.

In Afghanistan, drought also severely hit the southern part of the country. Ravaged by civil war, drought has emerged as an additional threat to life. It has inflicted heavy wounds to the Afghan nomads who are desperately trying to survive one of the severest droughts in the century. Hundreds of thousands of people have already migrated to the north from the drought-ridden winter grazing areas around the southern city of Kandahar. Due to shortage of grass, the nomads are selling their livestock at nominal prices. Prices of live animals have gone down to 20 per cent of that asked last year. Millions of Afghans are now facing a famine as the situation is going out of hands of the ruling *Talibans*.

What went wrong?

A drought is a natural phenomenon that generally occurs due to failure of normal precipitation. The most commonly used drought definitions are based on meteorological, agricultural, hydrologic and economic conditions/considerations. A meteorological drought is defined as an interval or time, generally of the order of months or years, during which the actual moisture supply at a given place cumulatively falls short of climatically appropriate moisture supply. Agriculture drought is typically defined as a period when soil moisture is inadequate to meet evapotransparative demands so to initiate and sustain crop growth. Hydrologic drought typically refers to periods of below-normal stream flow and/or depleted reservoir storage. Economic droughts are a result of physical processes but concern the economic areas of human activity affected by drought. Although, the definitions vary in terms of conditions/considerations, a drought should be treated in a holistic way because from failure of precipitation to economic and social impacts are inter-linked by a chain. The effects are propagated from one end of the chain to its other end.

So in terms of the above definitions, what went wrong this year across South Asia? Failure of rainfall in the drought prone areas has lead to the severe drought this year. However, lack of human interventions has further aggravated the situation. The likelihood of rainfall failure is high where annual rainfall is between 400 to 750mm and variability is more than 30 per cent. Failure of rains is less common in those areas that have an annual average rainfall of 750-1500 mm because of lower rainfall variability (10-20 per cent). But when they occur, they can be very destructive to dense population, small land holdings and marginal farmers. In the past, these two types of areas have been the hot spots for droughts and famines in India. This year, rainfall has failed by and large in the former area, which include some 19 *talukas* (subregional municipalities) in nine districts of Rajasthan, 50 talukas in 11 districts of Gujrat, and 87 talukas in 12 districts of Maharashtra and 88 talukas in Karnataka. Drought hit regions in Pakistan and Afghanistan are also fall within the arid climate. Balochistan is outside the sphere of South Asian south-west monsoon current and therefore receives scanty and irregular annual rainfall (about 100 mm). Seasonal temperature extremes are common in summer and winter.

Nearly 80 per cent of India's rainfall occurs between June and September. However, due to onset and retreat patterns, lengths of the monsoon vary widely across India and other parts of South Asia within the influence of south-west monsoon. For example, length of monsoon is about two months of July and August in Rajasthan, while in Gujrat it is about three months from the end of June to September. The remaining 20 per cent of rainfall is distributed amongst the remaining nine months. As early as the end of the last monsoon, the Indian Meteorological Department (IMD) noted that Saurashtra and Kutch in Gujrat had received 58 per cent deficient rainfall. The situation has got worse due to lack of pre-monsoon rainfall in Gujrat. On the other hand, Rajasthan has had some showers, but not enough to make a difference. In Balochistan in Pakistan, during January-April, on average, rainfall was 35-50 per cent lower than the normal over approximately 20 per cent of its area. In another 20-25 per cent area, rainfall deficiency was between 20-35 per cent. In the remaining area, rainfall deficiency was estimated to be 5-20 per cent. Rainfall situation in the southern Afghanistan is not known; however, it is believed to be similar to Balochistan.

Drought has had a huge impact on agriculture and livestock in Balochistan and Sindh.

Drought management

Drought is not an uncommon natural calamity in South Asia. India experienced 18 droughts during 1871-1990, of which 10 were severe and five were phenomenal. While the periods 1901-1920 and 1960-1980 had the highest frequency of droughts, 1921-1940 had no occurrence of drought at all. Most of the severe, and all the phenomenal droughts, occurred in the El Niño warming phase, which, therefore, needs careful monitoring. Bangladesh had experienced severe droughts in 1979 and 1994. Droughts are also common in the western Nepal, which is relatively drier than other parts of the country. Although, droughts have been in South Asia for centuries, this year it has sent serious shock waves to the policy planners and politicians.

Droughts handling can be divided into two main approaches: planning for drought and responding to drought which refers to crisis management. Panic amongst the policy planners and politicians have proved that appropriate holistic planning for combating droughts are not in place although over the years, the drought response system in India has undergone significant transformation. The drought response system in India changed from famine relief (before independence), to scarcity relief (until mid-1960s), and finally to drought relief (until mid-1970s), to drought management (at present). Drought management practices include both planning and crisis management components: (1) meteorological monitoring, (2) hydrological monitoring, (3) agricultural monitoring, (4) early warning-union government, (5) food security system, (6) employment project, (7) contingency crop plan, (8) social security schemes, (9) infrastructure arrangement, (10) water conservation measures, (11) drinking water supply, and (12) preservation of assets and infrastructure. However, if all these are parts of a continuous process then why get panicked?

In South Asia, especially India has made tremendous progress with regard to meteorological monitoring and forecasting. It has relatively dense network of meteorological stations, weather satellite, super computers for meteorological modelling and forecasting and high level institutions like the Indian Institute for Tropical Meteorology (IITM), Indian Meteorological Department, etc.

The IMD's main responsibility is to forecast the monsoon with the aid of a complex 16-parameter model which include physical inputs as temperature, atmospheric pressure, effects of El Niño, ocean temperature and snow cover in the Himalayan ranges and some other factors. However, the IMD is not in the business of predicting the drought. So the problem begins here. It is not exactly known who was in charge of drought forecasting and disseminating the piece of information from the top level to bottom grass-roots people. Organisations were blaming each other. As demonstrated in the print media, the drought was no body's child.

Hydrological monitoring, assessment and information dissemination were also unsatisfactory. Only in mid-April, the government in Gujrat issued a warning about alarming rate of depletion of water levels in all dams/reservoirs across the state. By the end of April, they were virtually dry. However, it did not happen overnight. An indication of potential situation of water in the dry season should have known to the concerned authorities immediately after the retreat of monsoon. The ground water situation is also bad across Gujrat. In many areas in Gujrat, groundwater was excessively tapped in the last 10 years. In 1991, there were five districts, which extracted between 85 and 100 percent groundwater. In 1997, the number of such districts increased to 11. The state government has grouped under 'Dark Zone' those districts which extract 85 to 100 per cent ground water; under 'Grey Zone' those which use 65-85 per cent; and under 'White Zone' those which pump less than 65 per cent and are considered within the safe limit. The number of districts under the 'White Zone' came down to eight in 1997 from 15 in 1991. The excessive exploitation of ground water was caused the water intensive industries like chemicals and sugar. In addition, agriculture policies have also encouraged over-exploitation. The ground water regulations were not enforced to halt over exploitation.

The union government in New Delhi is in charge of issuance of drought warning. The ministry concerned does it based on the meteorological information. However, this year the warning was issued when the situation became very critical. One official of the World Food Programme (WFP) made a remark that every body was sitting idle to see the situation getting worse because symptoms of a severe drought appeared as early as in November last year. Governments at the centre and state levels moved very slowly to tackle the situation. Political bickering over the issue also delayed the response programmes to go in action. Although droughts are recurring phenomena, it was evident that the state governments were not fully equipped to bring the situation under control because they were bargaining with the Union Government in New Delhi for additional resources. These incidents demonstrate the magnitude of negligence and ad hoc business at the highest political and policy makers' levels.

A drought can severely affect food security across regions, society, gender, etc. The recent drought in South Asia has demonstrated that food availability for a large section of the affected population is at stake. In India, the state governments were asking for additional funds to increase food supply. However, there is a time-lag between purchase and distribution which could seriously affect the nutritional situation especially for women and children. In Pakistan, when the military government was busy in packing up the constitution, democracy and an elected government, the situation went out of their grips. In absence of local governments in Pakistan, the military regime is struggling to manage the situation. This prompted them eventually to seek international assistance. The death toll due to drought related hunger in Pakistan is rising every day. The trail of destruction in terms of malnutrition and related diseases will mostly surface after the drought is over. In Afghanistan, the ruling *Taliban* regime is also struggling to control the drought situation. They are transporting food by helicopters in the remote villages of the southern part of the country. But this is a tip of the iceberg.

Drought across South Asia and its poor management underscores the need of a comprehensive re-evaluation of the management practices. It has unmasked several critical management issues. *First*, there is a gap between government and the vulnerable population. People were unaware of the potential danger ahead of them because they were not communicated the forecasting message. They were also not communicated about the risk of summer crop plantation. *Second*, drought has raised a question about effectiveness of large-scale water development projects. Gujrat has a large number of dams/reservoirs, however, they proved to be ineffective in reducing the damage of drought. Villages that worked together to maintain wells, rainwater runoff channels and the centuries old circular water pits, covered by domes, had been doing better. They delivered commendable services in saving cattle-heads and crops and ensured water supply for domestic consumption. *Third*, an emergency stock of food grains is necessary in the high-risk areas. During the drought shortage of food grains was felt in the affected areas. Additional food grains will be needed to meet the gap created by reduced harvest. In addition, a regional emergency food stock is required to be contributed by the South Asian countries. After the 1979 drought, Bangladesh promoted the idea of such regional food stock.

However, it did not receive much attention at the political level. If created, the regional emergency food stock will be able to save many lives as time required for importation from other remote countries can be averted. *Fourth*, disaster management has to be integrated with the broad national development framework. Natural disasters like droughts and floods threaten economic, social and environmental dimensions of sustainable development. Disasters deplete natural assets. Thus, loss of natural capital plays a crucial role in limiting development. The losses could be propagated via capital markets, depreciation of domestic currency, greater indebtedness, etc.

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In India, nearly one-tenth of the total population has been affected by drought.

Duel with a deadly disease

Identification of sources and release mechanism of arsenic in the subsurface is of utmost importance towards development of remedial technology. However, very little has so far been done in this regard, write Saraban Tahura, S M Shahidulla, Tafizur Rahman and Dr Abul Hasnat Milton

THE government, in collaboration with international agencies, has taken up two types of mitigation programme: one is the development of household and community-based arsenic remedial technologies so that people can treat the contaminated water from the shallow tube-wells; and the other involves installation of deep hand tube-wells. Other than groundwater treatment units and sinking deep tube well, a few alternative options have also returned success, albeit on a limited scale.

However, there hasn't been much work on identification of sources and release mechanism of arsenic in the subsurface, which is of utmost significance towards development of remedial technologies. For example, arsenic from pyrites releases in groundwater because of aeration promoted by excess extraction, but extraction of groundwater may not have direct impact on release of arsenic from arsenic rich iron oxy-hydroxide. Again well aeration technology won't be successful if arsenic releases from arsenopyrite. Although sources and release mechanisms are controversial, huge amount of money is being spend in the name of developing arsenic removal technologies which is nothing but giving a chance of making money to a vested quarter. There is also wastage of money in the programmes of evaluation of existing arsenic removal technologies. Two most probable sources and release mechanisms are assumed to be responsible for arsenic contamination in groundwater: a. arsenopyrite and pyrite; and b. arsenic-rich iron oxy-hydroxide. In fact, these two sources and probable release mechanisms are contradictory.

Samples collected by local researchers from different arsenic-prone areas indicated arsenic to be associated with iron oxy-hydroxide coatings on sand grains of varying thickness. They concluded that adsorbed arsenic may undergo dissolution through reduction process caused by organic acid produced from anaerobic decomposition of organic wastes or at low pH. Arsenic associated with iron oxyhydroxide may be disrupted by competing ions such as phosphate ion and hydroxyl ion at very high pH value exceeding 8 and thus may release into ground water.

But according to Indian researchers who also collected bore-hole samples from arsenic-affected areas in India, arsenic-rich particles came in sediments from iron pyrite. They concluded that increased pumping cause declination of water table which exposes minerals to atmospheric oxygen and due to oxidation of pyrite and arsenopyrite arsenic associated with them release into groundwater.

In fact, both the hypotheses are conflicting and controversial. Extensive researches on bore-hole samples collected from different areas are needed for proper understanding of the very complex underground behaviour.

Whatever may be the source or mechanism of the arsenic release – oxidation, reduction or both – the fact of the matter is, our groundwater table is gradually declining due to its continuous discharge in rural and urban areas. Although groundwater reservoirs are being replenished after infiltration from precipitation, rivers, canals and so on, the discharge rate is much higher. So if this discharging process continues our shallow groundwater reservoir will be exhausted eventually and proportion of arsenic may further increase.

Besides, available arsenic removal technologies are neither cost effective for the poor nor easily operable and maintainable.

For example devices based on sorptive techniques need periodic regeneration by washing as flocculate particles clog the filter media slowing down flow rate which makes those devices cumbersome to use. After some days there may arise the necessary to change the filter media which demands extra replacement cost. Another process is coagulation-flocculation-co-precipitation with chemicals that may leave harmful residual elements in dissolved state in water. If coagulated with alum and potassium permanganate, there is a chance of having residual aluminium in treated water that may have toxic effects on human nervous system. Again manganese may contribute undesirable tastes to beverages and stains to laundering. Even we don't know whether these technologies are efficient in removing a significant portion of arsenic or not.

Existing arsenic remedial technologies and installation of deep tube-well programme is like cutting a tree to its root and then watering the branches to enliven it. A superstructure can't stand without safe foundation. Foundation should be constructed or reconstructed first and then the superstructure.

So should we not search for an effective alternative as a safe source of drinking water rather than go for arsenic removal technologies and installation of deep tube-wells, which may solve our current arsenic problem? The alternative options may be surface water or rainwater through proper management.

In Bangladesh, the average annual rainfall is about 1500mm and rainy period is average 5-7 months. So rainwater can be stored during rainy season and can be used in dry season. For a family of five members 50 litre/day is sufficient to provide water for drinking and cooking purposes. So a circular tank made of concrete or galvanised tin may be designed as follows:

Volume, Q = 50x6x30 = 9000 litre = 9 cubic metre

Height of tank with 150 mm clear, H =1500+150=1650 mm =1.65 metre (5ft 5in)

Area required, A = Q/H =9/1.65=5.45 square metre

So, diameter of the tank, D = (A/3.14) =1.32 meter = 4ft 4in

Rainwater can also be stored in a community based sanitary protected pond. It must be kept free from any kind of alga growth, organic wastes and pathogens. In that case, needed is hand tube-well for withdrawal of water. It will be more cost effective than household based. Rainwater harvesting will contribute to no natural effects. This process will not only save our natural underground reservoir but will ensure safe water to the arsenic affected people.

Sanitary protected dug well is a good option for providing arsenic free drinking water rather than shallow tube-well. As the water surface is open to atmospheric oxygen in that case, ferrous will be oxidised to ferret and arsenic associated with iron will get precipitated, thus arsenic-free water can be extracted by hand pump.

Surface water such as pond water, river water etc can also be used through:

(a) Disinfecting by boiling, ultraviolet radiation i.e. ultraviolet ray lamps, using chemicals such as bleaching powder, iodine, ozone etc

(b) Filtration by Pond Sand Filter and other household small filter

Surface water can be used in large scale through storage in distribution reservoirs after chemical coagulation-flocculation-sedimentation-filtration followed by distribution of treated water to household by pipe system. If this system be efficient and cost effective then it may be an excellent and acceptable option for the users.

What might be the solution and whoever may solve the problem doesn't matter, the solution itself is urgently needed. Still there is time to ensure safe drinking water to all and thus save our lives.

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