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Pragyambu

cGanga
Centre for Ganga River Basin Management and Studies

The purpose of this quarterly digest brought out by the Centre for Ganga River Basin Management and Studies (cGanga) led by the Indian Institute of Technology Kanpur is to disseminate valuable traditional and scientific knowledge assimilated from national and international sources on various aspects of management of water and river restoration and conservation among concerned institutions and citizens.

WHERE DID THE RAIN FROM THE CLOUDS END UP?

In the previous issue of *Pragyambu* we dealt with various aspects and issues related to floods. In this issue we will continue the discussion in Indian context and look for possible solutions to the problems created by floods and ways to harvest rainwater. Our discussion begins with Bangalore, which is considered the Silicon Valley of India. However, these days it is in limelight due to the prevailing water crisis in the city. The groundwater level in Bangalore and its adjacent areas has reduced to a minimum and in some places it has nearly disappeared. Bangalore was in news during May 2023, but for different reasons — that time it was facing excess rainfall. Even before the onset of monsoon, heavy waterlogging during pre-monsoon showers led to flood-like situation in the city. Even before these events, during 2018 to 2022, the Karnataka region, particularly Bangalore city, had faced excess rainfall and flood like situation. These instances indicate a gap in our understanding of water management and mistakes made in its implementation. These errors lead to extreme events like flood and drought.

The conditions prevailing in Bangalore are not an isolated case; instead, such consequences of errors in water management are evident in many other Indian cities also. For example, taking note of the falling water levels in the water sources, the local administrations in Ghaziabad and Pune have also issued red alerts. It is not hard to imagine such scenarios arising in other cities also in future. There are several manmade causes behind such situations, such as:

NEGLECT OF LOCAL WATER SOURCES

Before the advent of large dams, cities in our country were dependent on local sources for supply of water, such as ponds, lakes and small rivers located in and around the city, and sources of groundwater such as wells. In the case of Bangalore, there were once 400 lakes in the city which have now reduced to a mere 65. Similar condition is found in Hyderabad also, which once had more than 3000 natural and man-made ponds and lakes, but the number has now reduced to 500. The situation in Chennai and other cities is also more or less the same. Due to unplanned development, the natural routes of transport of rainwater to these water sources has been obstructed, due to which cities are relying on rivers for the required water supply. On one hand, this affects the resources and health of rivers, and on the other hand unexpected flood and water-logging are disrupting urban life.

Now the question arises — how to revive these water sources? The first method is to remove obstacles in the path of surface runoff (rainwater flowing over land surfaces) reaching these sources. This should be done after study of the slope and plains of the concerned region. There have been instances where embankments, which were at a higher elevation than land, were constructed around ponds. Consequently, rainwater could not reach the ponds. Removing such obstacles will not only resolve the problem of water-logging in the cities but also aid in water conservation. The case of Bhopal, the capital of Madhya Pradesh, is an example of the benefits brought to a city when surface water is conserved in lakes or ponds. Surface water conserved in the 11th century pond constructed during the reign of King Bhoj fulfills the demand for water of the city's population even today. Even today, the residents of Bhopal city are provided water from this pond. Considering the socio-economic diversity in the country, it may not be possible to replicate the example of Bhopal everywhere; however, already existing ponds and lakes can definitely be revived. One way is to renovate the routes which used to bring water to these lakes and ponds. Another method is to feed wastewater emanating from cities after proper treatment. Common people still have reservations about using treated wastewater directly. In such cases, if treated wastewater is released into moribund lakes and ponds, then the surface water sources can be revived. Revival of surface water sources has two benefits. Firstly, recharge of groundwater will begin by natural processes such as infiltration. In simpler terms, the presence of ponds at any place helps in recharging the

Figure 1: Transforming brown water bodies into blue water bodies by replenishing them with their own treated water

The restoration of surface water sources offers numerous advantages. Firstly, natural processes like infiltration will initiate groundwater replenishment. Secondly, the restoration will revive the ecosystem, encompassing land, the local environment, and water, which had previously been degraded. Witnessing the presence of aquatic creatures in treated water will shift the general population's perception towards its usage, potentially garnering public approval for non-drinking purposes. Consequently, this will alleviate the pressure on major rivers to supply water to densely populated areas.

groundwater of that place. Secondly, the ecosystem which had been destroyed in the absence of water will now be revived. The perspective of general population towards treated water will change when they see the presence of aquatic creatures in treated water. This way, the usage of treated water for purposes other than drinking will get public approval. This will eventually reduce the burden on big rivers to provide water for large populations. Innovative solutions can be searched by aligning treated water and moribund water sources in different cities. For example, boating can be started in such waters, which will provide employment to people, and also provide alternative means of entertainment, tourism and transport. Also, sight-seeing places such as parks and nature walks can be developed near these ponds. Different solutions can be found for different cities considering parameters such as their geography and the distance of water source from the wastewater treatment plants.

FLOW AND VOLUME

Two factors play major roles in creating circumstances that result in floods — first is the volume of water and the other is the speed of flowing water. Efforts made to control rainwater at local level is the first step to reduce the severity of floods in large rivers and control losses caused by them. Several lakes and ponds act as wetlands for rivers and function as a sponge for those rivers. As per requirement they provide water to the rivers and sometimes stop the river water from overflowing on the surrounding land. By reducing the flow of water on the surface, thereby making it sluggish, the occurrence of flood can be postponed for some time. This will give ample time to the administration and residents of the flood-prone regions to make necessary preparation to handle the situation.

THE SCIENCE OF FLOODS

There is potential energy in water. When a river flows, this potential energy gets converted into kinetic energy. The kinetic energy of river water affects the hydraulic force of water. Every obstacle in the flow of river has to face this hydraulic force. This force has the capability to destroy big rocks or to change their shapes. This is the reason that we find spherical pebbles inside and on the banks of rivers.

Let us now imagine the scenario of heavy rainfall in high altitude locations. In such a case, water will flow downhill and assisted by Earth's gravitational force, the potential energy of water will get converted to kinetic energy. Steeper the slope, higher will be the flow and amount of water. This will have additional contribution from seasonal waterfalls, streams and drains. When water reaches the river in excess of its water carrying capacity, it gives rise to flood-like situation. Flood is a natural action of the rivers and acts as a cleansing mechanism. However, its flow needs to be made sluggish lest it becomes disastrous for humans.

Let us examine ways in which flow of river can be made sluggish so that its disastrous consequences can be averted.

There are several natural ways to make the surface runoff sluggish. Large trees, bushes of medium size and ordinary grass play important roles in reducing the speed of flow of water. Research should be done on different species of grass to identify the particular species of grass which is most useful for water absorption and stopping soil erosion. Our ancient scriptures Puranas contain examples of reducing the flow of river with the help of plants.

GANGA DESCENDED ON EARTH FROM THE MATTED HAIR OF LORD SHIVA

In Hinduism, the message of conservation of nature and environment is promoted with the help of symbols and allusions. According to a tale in the Puranas, when Ganga had to descend on Earth, the gods were worried lest the heavy flow of Ganga causes catastrophe on Earth. If such heavy flow happens, then instead of bringing the intended benefits, it will cause disaster. Everybody was pondering over possible ways to control the flow of the river. At that time, Lord Shiva placed Ganga on his head and Ganga descended on Earth through the matter hair of Lord Shiva. His matted hair reduced the speed of flow of the river due to which the feared flood-like situation was averted and the purpose of Ganga's descent was fulfilled.

If we try to understand the symbolism in this tale then we will find that the matted hair of Lord Shiva represents the presence of vegetation. This matted hair appears in the form of deep roots of trees, bushes and shrubs found in forests. Thus, the message of the aforementioned tale is that these vegetations act as a bridge between humans and river, which protects the river from human interference and also humans from the flow of river. Just like the various forms of Lord Shiva, this vegetation can also take several forms, such as the forests on the Himalayas in the context of the Ganga. According to traditional knowledge, there used to be a forest of birch trees in a place called Bhojwasa near Gangotri, which has now nearly disappeared. In Indian context, the conservation of forests and grasslands can prove to be a good means of protection from floods.

In foreign countries, swell drainage is constructed in flood-prone areas to store flood water and minimize the loss of life and property. It is a temporary construction, where water is left in natural state to get converted into marsh or algae. Insects, fungi and algae grow there and enrich the natural ecosystem. In the Netherlands, surface runoff has been connected with the network or canals to beautify the landscape. In the United Arab Emirates, which does not have any river, and groundwater is also negligible, rainwater is obtained by artificial means and collected in artificial lakes. Some of these lakes are converted into tourist spots, whereas others are used to store water for drinking purposes. The socio-economic conditions of these countries is very different from India's, still they are adopting means of water conservation. Being a developing nation, India should also strive to adopt these methods.

AND FINALLY

TDS IS NOT A BIG PROBLEM

Another challenge with treated water is the increased total dissolved solid (TDS) of water. To solve this problem, experts advise adopting the technology of reverse osmosis (RO), which in turn has some economic and practical problems. If the purpose of this water is merely to recharge the surface waterbodies (such as ponds and lakes), then the problem of TDS can be neglected. The basis of this suggestion is that when rainwater reaches these water sources during monsoon, then the concentration of TDS will automatically decrease and equilibrium will be established. It should be kept in mind that it is not enough to just discharge the treated water into these sources, instead proper management of these sources is also necessary and the silt deposited in them should also be cleaned from time to time.

Here another point of importance is rainwater conservation. The last two decades have witnessed an increased awareness towards rainwater conservation. People are making arrangements for rainwater harvesting in their homes. In the same way district administration should also become pro-active towards recharging local water sources by surface runoff. Recharging local water sources by surface runoff is simple and less expensive. This idea can only be implemented by a planned effort made by local administration before the onset of monsoon. On one hand, this will enhance the percentage of surface water of a region and on the other hand, the water discharged from cities will accumulate in local water resources and make the city water-rich. This water would otherwise reach small rivers and eventually large river thereby increasing its water level and creating flood-like situation.

When water conservation movements were initiated on a large scale in the past, there were complaints that expected water was not reaching the large dam projects. According to water experts, this is not a cause for concern because when the reduced groundwater in the basin of any large river returns to saturation point, then the reservoirs of large projects will also get replenished in the next monsoon.

Figure 2: Traditional knowledge and its science

Efforts are ongoing at many levels to free rivers from nutritional enrichment and their encroachment by aquatic weeds. For example, the use of organic fertilizers is being encouraged in place of chemical fertilizers throughout the country. Many scientists in India and United Kingdom are doing independent and joint researches for balanced use of nitrogen in agriculture and prevent excess nitrogen from entering waterbodies. The growth of aquatic weeds can also be curbed by restoring the continuity of the rivers. Efforts are going on in this direction as well. With the combination of modern science and traditional knowledge, we should be able to hand over the gift of safe water sources and food security to future generations.

THE ECONOMICS OF WATER

Pressure created by obstructing the path of surface runoff and neglecting local water sources has consequences on economics also. Today drinking water in large cities of India is getting expensive every year, because the demand for this water is being fulfilled from rivers flowing 50, 70 or 120 km away from city centres. The cost of bringing water from such large distances to the cities and the cost of energy involved in this process is borne by the government and eventually by common citizens in the form of water tax or monthly expenditure for drinking water. The new project, which is being constructed on Cauvery river for supplying drinking water to the Bangalore city, is situated at a distance of 95 km from the city. The cost of bringing water from such a large distance will obviously be high. In Indore, which is called the financial capital of Madhya Pradesh, drinking water used to be provided by local sources till the 1990s. However, slowly the city became increasingly dependent on water from Narmada river. Today Narmada provides drinking water not only to the city but to rural areas also. The Narmada treatment plant is located 79 km from the city. Water is pumped from the river valley to a height of 534 metres in 5 stages. 10 crore rupees are spent every month on electricity required for the whole process. Still, the city gets water only once in two days. If this requirement of water was fulfilled from local sources, then large savings could have been made by government and citizens.

Similar to Karnataka, central India also receives good monsoon, and every year gets approximately 40 to 50 inches rainfall. On the one hand, government and citizens suffer economic losses caused by flood and water-logging, and on the other hand they spend a large amount of money on basic necessities such as water.

The time has come for us to understand the difference between usage and consumption of water. We need to reduce the circumference of the circle of water usage, and inculcate the habit of using recycled water. In addition, decreasing amounts of water should be extracted from water sources. If this is not done, then in spite of meeting all standards of physical development, we will remain lagging behind in terms of water and sustenance.

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