



**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.**

## FLOOD: A DISASTER CAN BECOME A BOON WITH EFFECTIVE MANAGEMENT

**T**oday approximately 360 crore people all over the world are facing water crisis. By 2050, this number will increase to 500 crore. According to the Global Water Resource Report 2023, the flow of rivers all over the world is below normal. On the one hand we have this report warning of the water crisis and on the other hand our cities and villages are getting inundated. For example, approximately 16 lakh people were affected during the flood in July 2024 in Bihar, and there was a loss of crops worth approximately 350 crores. Assam suffers a loss of about 200 crores every year due to floods. These data are from only two states; if we analyse the effect of flood in the whole country, then the data of loss to property and life will be huge. However, if we put the losses of life and property aside and think only about water, then it would appear that flood implies an increase in water level of river, i.e., an abundance of water. The question arises whether the floods, i.e., increased water level of rivers can save us from the water crises of future. In India, which is a country of rivers, did floods occur in the past also? How were floods managed during that time?

Let us examine the facts, understand geography and history, and analyse the present to explore solutions to this problem. First of all, let us try to understand this question – whether flood implies abundance of water. If indeed flood implied abundance of water, then drought-like situation would not have developed during summer in most states, particularly in large cities, in spite of having suffered floods every year. Although flood is a natural event, due to the present circumstances which are responsible for floods, drought and flood have become two sides of the same coin.

Nature bestows the gift of rain upon us, but we do not have the means to store that gift. As a result, the gift goes waste. The availability of water in any area depends on the inter-relationship between groundwater and surface water in that area. These inter-relationships are important for increasing the groundwater level and completing the process of water replenishment in rivers. At present, several cities face floods in spite of low rainfall because of weak inter-relationship between surface water and groundwater. Besides, the factors essential for important processes, such as controlling the flow of water, increasing water absorption in soil, area decreasing, e.g., diminishing of gardens and green patches in cities. Changes in land use, such as conversion of forest cover and agricultural land into residential area, encroachment of wetlands, and several such factors lead to a reduction in the rate of water absorption in soil. Extinction of drains in the cities is another important change. By 'drains' we do not imply dirty drains, instead we mean storm water channels which are a medium for rainwater to flow out of the area.

The inter-relationship between surface water and groundwater has been explained in simple terms in a primary level textbook of NCERT. An extract from the book is as follows: "The ponds and lakes of various sizes in our villages and cities fill up water in the piggy bank of earth. The water stored in them seeps through and mixes with the store of water hidden below the surface of earth, and enriches our store of groundwater. This treasure of water is not visible to us, but due to this treasure we can extract water for our consumption throughout the year after the monsoon season has passed". We have stopped filling our piggy bank,

or in direct terms, we are not collecting rainwater properly. Hence, flood cannot be connected to abundance of water. C-Ganga has proposed a plan with the title '330-35'. Its fundamental principle is to conserve water during 35 days of monsoon so that there is no scarcity of water during the remaining 330 days of the year.

Now, let us discuss the second question. India is a land of rivers, and floods in rivers are natural processes. So how were floods managed in the past? Rivers have been flowing in India for centuries, and the Ganga, Yamuna, Brahmaputra, Narmada, and Kaveri have been described in millennia-old literature. Now floods are a natural event which used to occur earlier also. However, floods have become more severe in the last few decades and their frequency has also increased. At several places, flood-like situations develop even after low or normal rainfall. In our country of large geographical diversity, the cause of flood is different in every state. Bihar faces the wrath of flood every year. Several factors are listed as the cause of flood in Bihar, some of which are natural and some are anthropogenic. Several times, the anthropogenic factors increase the severity of natural flood. One such factor is elevated river, which means that the flow of river has risen higher than its natural level. Embankments were constructed on rivers in Bihar with the idea of getting protection from floods. The results turned out to be contrary to this idea. Construction of embankments led to a change in the natural expanse of rivers. In the presence of embankments, rivers cannot spread out in width, instead they rise above their natural levels. When the elevated river flows rapidly, it leads to severe flood. According to an article published in the Economic and Political Weekly, the British

constructed embankments on the rivers in Bihar in 1854, and in 1864 they stopped the construction of embankments because in the meantime they had realized that construction of embankments cannot stop floods. After independence, embankments were again constructed on rivers in Bihar in 1954. In 1954, there were 160 km long embankments on rivers in Bihar and the flood-prone area was 25 lakh hectares. At present, there are 3,465 km long embankments on rivers in Bihar and 6,89,000 hectare area is flood prone. Dam management is also considered to be a reason behind floods in Bihar. Detailed discussion on this aspect is presented in the following pages. The geography of Assam is such that water from neighboring areas such as Sikkim, Arunachal Pradesh, Tibet and Bhutan reaches Assam due to natural slope giving rise to flood-like situation. Cyclones arising in oceans lead to flood and destruction in coastal states, whereas unplanned development, obstruction of the rainwater drainage system, and decrease in the number of surface water sources are the main causes of flood in the plains and megacities. Now let us discuss how rainwater management in the plains was done in ancient times and how modern problems arose from the demolition of ancient systems.

In Indore, Madhya Pradesh, ponds, tanks and wells recharged by rainwater have been water sources for a long time. Today most ponds in the city have dried up and the city is dependent on the Narmada River for its water supply. On the other hand, the city faces waterlogging even with normal rainfall and people face great inconvenience.

Leaving aside Indore which is growing into a mega-city and looking at its neighboring district of Devas, we find a good example of rainwater conservation which has been replicated in the whole of Madhya Pradesh. Some time ago, Devas was facing water scarcity. Then, in 2007, the Balram Tank Scheme began, in which farmers had to dig ponds to harvest rainwater on a 10th or 20th portion of their farmlands with financial aid from the state government. Post monsoon, the pond water is used for irrigation and recharging groundwater. The pond water is also shared with nearby farmers. Under this scheme, 16,000 ponds were constructed in Devas district. Within 2-3 years, irrigated land in the area increased from 18 thousand hectares to 4 lakh hectares; the income of

farmers also increased. After its success, the scheme was extended to the whole of Madhya Pradesh, with positive results in the state. Several farmers also started fisheries in the Balram Tank, thus increasing their earnings. The results of water conservation are seen not only in Devas but in entire Madhya Pradesh, particularly in Gwalior-Shivpuri. Traversing these regions now, one comes across several ponds and streams full of water even in the dry season.

## WATER HARVESTING

In simple language, the above example may be termed water harvesting. Through this method, farmers can augment their earnings from the harvested water in addition to crops growing in their fields. In the above example, ponds were created with government support. This template can also be followed to dig private ponds with pond water being available for sale. Even if the ponds are made for such financial gain, they will recharge groundwater and harvest rainwater.

Let us now cast a glance at South India. This year, Karnataka faced severe water crisis during summer. Once upon a time this state used to be very rich in water and other natural resources, whose main reason was proper water management.

In Mysore state (presently part of Karnataka state), there were 39,000 ponds before independence, which were maintained by the state. There was a saying about this state -- if a drop of water falls on a hill near Mysore and splits into two droplets, then ponds would be present on both sides to preserve them. During British rule, expenditure on the preservation of thousands of ponds seemed extravagant to the government, and it stopped the maintenance work of the ponds. Negligence of the ponds continued even after independence. At some places, there was encroachment on ponds, and at other places garbage was dumped into them, and thus the rich water heritage of the area became extinct. Before British rule, there was a pond named Tandua in the Durg area of east Madhya Pradesh, from which a 513 miles long canal was taken out. History recounts that rulers Chandragupta, Samudragupta, Ashok and Mughals also constructed ponds during their reigns. Ponds were also constructed by Rajput kings of Rajasthan. The pond which was constructed by King Bhoj in

the 11th century in Bhopal is catering to the water needs of the city even today.

There were two benefits of preserving water in ponds – first, collection of rainwater and second, recharge of groundwater. These ponds strengthened the inter-relationship of surface water and groundwater, enriched groundwater and also supplied water to rivers during summer. In scientific terminology, the recharge of rivers by groundwater is called ‘gaining river’, and no recharge is called ‘losing river’. Several main rivers of the country start from the glaciers in the Himalayas. Some rivers originate from groundwater and after monsoon are recharged only by groundwater. Examples of such rivers include Gomti in Uttar Pradesh, and Narmada and Kshipra in Madhya Pradesh. At present the groundwater level is reducing, consequently we are losing several small rivers which are dependent on groundwater for their flows. Several large rivers are also in danger.

The instruction of the National Green Tribunal is a ray of hope for rivers and water sources on the verge of extinction. Several social groups had filed a public interest litigation regarding these rivers and water sources. In its response, the National Green Tribunal instructed all states and union territories to prepare an inventory of their different water sources, including wetlands. It is a welcome initiative, though it is the preliminary step of a long path. The government, administration and citizens have a long way to go for the rejuvenation of rivers.

In ancient times, there was arrangement for collection of rainwater and floodwater. Besides, there was arrangement of drainage of water from urban areas. Due to unplanned development, the drainage system for rainwater became obstructed. This is another reason that even a spell of normal rainfall results in water clogging problem in cities. On the other hand, in the absence of a proper sewage network in several cities, the natural drains, small rivers or storm water channels are being used as wastewater drainage line. Mixing of rainwater with wastewater leads to wastage of water resources, and its negative effect is seen on the sewage treatment plant. If rainwater mixed in wastewater spreads in the city by accident, then it becomes a public

health hazard. Such incidents have occurred in the past.

The obstruction of rainwater drainage in cities results in several problems. This is why the water drainage system has been given importance in the Swachh Bharat Mission 2.0, which is a welcome initiative. Along with water drainage, the collection of water should also be given proper attention. While Bihar and Uttar Pradesh have a history of flood occurrence, these days flood is also occurring in cities in Rajasthan. Negligence of the ancient water collection system of Rajasthan is the reason behind these floods. Water has always been a precious resource in Rajasthan, hence rulers constructed lakes and step-wells to preserve it. After independence, when Rajasthan started getting adequate water from the canals of Punjab and Haryana, the local administration and people neglected these systems. As a consequence, cities get inundated even with a normal monsoon rainfall, whereas water crisis keeps looming during summer. Deserts receive below normal rainfall. On top of it, the rate of water absorption by soil is very low because water cannot stay on sandy soil. This is the reason that we come across man-made lakes in Rajasthan, which is a desert region. This same principle is being followed in the United Arab Emirates, which receives approximately 5 inches annual rainfall. The government there preserves every drop of rain in lakes. In order to make the city flood-resistant, London is also working on a surface water collection system. Work is in progress in China on the principle of sponge city. Wetlands, grasslands and urban forests are being developed in cities there so that maximum absorption of rainwater can take place.

## SUCCESS STORY OF WATER HARVESTING

An example of successful preservation of rainwater in ponds can be seen in the Devas district of Madhya Pradesh, which used to have water shortage. In 2007, the Balram Talab Yojana started here under which farmers have to dig ponds on a 10th or 20th portion of their agricultural land. The state government provides funds for digging of these ponds in which rainwater is collected. After monsoon has passed, the pond water is used for irrigation and recharging groundwater. The water of this pond is supposed to be shared

with neighboring farmers also. Under this scheme, 16,000 ponds were constructed in Devas district. Within 2-3 years, irrigated land in the area increased from 18 thousand hectares to 4 lakh hectares; the income of farmers also increased. After its success, this scheme was implemented in whole Madhya Pradesh, with positive results. Several farmers started fisheries in ponds, thus increasing their income. Such results of water conservation is seen not only in Devas but in the whole of Madhya Pradesh, particularly in Gwalior-Shivpuri. While travelling through these regions, one can come across several ponds and small rivers which are full of water even in non-monsoon season.

## WATER HARVESTING

In common parlance, the aforementioned example can be called as water harvesting. Through this method, farmers can make an earning from the water collected in the field in addition to the crops growing in their fields. In the examples mentioned above, ponds were made with the help of government support. This template can also be followed for making autonomous ponds, and the water collected in them can be sold. Even if the ponds are dug for financial gains, these will recharge groundwater and collect rainwater.

## FLOOD IS A NATURAL EVENT

River flooding is a natural event. Through

flood, river distributes nutrients which enhance the fertility of soil. Also, different minerals, salts and several other nutrients reach the ocean when river flow mixes with it, and thus complete the aquatic ecosystem of the ocean. Just as the tides in the ocean are a natural occurrence, in the same way river flood is also a natural event. River flood is an annual cycle which gives completeness not only to the water cycle but also to the whole ecosystem.

## SYMBOL OF COMPLETENESS

Flood is called as 'Puur' in our local dialects; the word means 'completeness'. Flood in river completes the natural actions of the river. Different regions connect this important activity of nature with religion and culture. In the folk culture of Bihar, river flood is welcomed; when floodwater touches the doors of their houses, people consider it as an auspicious sign. In fact, people do not consider it as flood until it reaches the roof of any house in the village. When the Godavari river in Nashik and Kshipra river in Ujjain expand beyond their banks and reach the nearby temples, the people there rejoice. Such temples can be found in every state where floodwater reaches once a year and people consider it an auspicious occasion. On the other hand, if in any particular year floodwater does not reach these temples, then it is considered to be a sign of drought or some other disaster.

# Flood Management is Possible

A good example of establishing a connection between river, pond and groundwater is Suraha Taal in Balia district of Uttar Pradesh. This pond is connected to the river Ganga through a drain. When the water level of Ganga River is low, the water in pond flows down the drain into Ganga River. In rainy season, when the water level of Ganga River increases, the water of Ganga in turn flows to the pond and the size of the pond increases. This same pond again shrinks during summer season. Canals also emanate from this pond and provide water to the nearby rice fields. This pond also acts as a medium of groundwater recharge in the region. Local farmers consider this pond to be a boon, because with its help they are able to harvest black rice and develop fisheries. According to locals, Suraha Taal is a natural pond. On the other hand, there is Choudhary Charan Singh Lift Canal (formerly Dohari ghat Lift Canal) in Balia district. This canal supplies water to several ponds, and several sub-canals from those ponds provide water for agriculture. During excess rainfall, this canal protects against flood and distributes water to local ponds. During summer, these same ponds return the water they had collected during rainy season to Ghaghra, Chhoti Ghaghra (Saryu) and Ganga rivers.

Today flood appears to be a problem to us because we have interfered in the natural action of the rivers and encroached upon the land which naturally belonged to the river. During floods, rivers retrieve the land which belong to it from humans, but we think that rivers have caused havoc. We do not have to stop floods, instead we have to accept them and learn to manage our lives in the presence of floods.

### WORK FOR 35 DAYS, COMFORT FOR 330 DAYS

The Centre for Ganga River Basin Management and Studies (C-Ganga) has proposed a plan for preservation of rainwater. Its 35-330 plan lays emphasis on planned usage of floodwater. In India the monsoon usually lasts for two months. If we stay alert for managing rainwater during 20 days before monsoon and the first 15 days of the first leg of monsoon, then water will be easily accessible to us for the remaining 330 days. Lakes and ponds were constructed in different cities according to their peculiar geography. With passage of time, the various natural slopes and plains in the region undergo change due to different construction activities. In such cases, the district administration should ensure that rainwater reaches the ponds according to the local environment. Clearing of silt deposited in small rivers and removal of obstruction in drains before the onset of monsoon would save the city population a lot of trouble. It would also ensure that water is preserved in the pre-existing water sources.

### HARMONY OF NATURE AND SCIENCE WILL PROVIDE SOLUTION

To tackle the problems created by floods and droughts, we have to connect the local water sources to each other. Every city has some natural slope, which can be studied and accordingly the ponds, lakes and rivers passing through the city can be interconnected. In this linking process, water reaches from one source to another source aided by gravitation. This interlinking will be helpful in controlling the problem of water-logging in the city and will salvage us from the problems posed by urban floods.

In addition, recharge of groundwater would also be possible. Interlinking of water sources on a local level will prove to be more beneficial than interlinking of large rivers. The interlinking of local water sources in Amsterdam city is famous all over the world. It not only makes the city rich in water resources, but also enhances the natural beauty of the city. Besides, it also provides alternative modes of water transport and entertainment. Today several cities in our country are facing the problem of traffic congestion, while water sources of every city are struggling for existence. By preserving these water sources and maintaining a minimum water level and depth in them, we can produce new alternatives of employment and transport. The cities which are working on new master plans should give this a serious thought. In the cities where such natural slope is absent and it is no longer possible to restore the natural slope, engineering and technology can be used to make this interlinking possible. In this method, gates and sensors are set up between water sources. When the water level of one source rises due to an increase in water in the region, then this rise is identified by the sensor. Accordingly, the gates are opened and water is sent to the other source. This task can also be accomplished with the help of resources such as pumping. Several examples of this method are seen in western countries.

If we want to see a regular flow of clean water in our cities, then there is another important aspect -- to reduce the boundary of the water cycle, or in other words, to close the water cycle at the proper temporal and geographical scales. At present, the situation is just the opposite. For water supply, we are taking water from rivers situated 70 to 100 km away and the wastewater is reaching big STPs away

from the city after flowing several kilometers. We need to decentralize the water treatment system. We need to make such arrangement that water is treated locally or at township level and the treated water is made available for developing and conserving local water sources, or preparing new water sources. It should also be available for reuse in gardens, washing vehicles or catering to local needs in the same region. Any such arrangement will only save us from water- and environment-related problems in the future. In this regard, you can read about the process of water treatment in four steps in previous issues of Pragyambu. In addition, our government and administration should give priority to land allocation for water treatment. Along with land allocation, maximum utilization of land should also be emphasized. High-rise water treatment could be a possible solution for this.

### NEED TO INCREASE HARMONY ACROSS BORDERS

For flood control and management, the Indian government is investing in flood management programme and trans-boundary flood management programme. Under these programmes, cooperation and coordination among neighboring countries (such as Nepal, China and Bangladesh) for providing warnings on flood will be encouraged so that such warnings can be received well in time. Recently, China has announced the construction of the world's largest dam on Brahmaputra River. Considering this, it is necessary for India to proceed at diplomatic level with strength and wisdom while also maintaining coordination with neighboring countries to ensure safety for its citizens from flood. This would ensure timely exchange of information. Besides this, the central government is also working on river linking project with the hope that linking of rivers would help in solving the problems of flood and drought.

### Whole World is Working on Surface Water Collection

To save London city from flood, Thames Barrier and 400 small barriers were constructed several years ago. In spite of these efforts, London is facing the problem of floods which are expected to increase in future. To address this problem, environmentalists of London are demanding construction of ponds in public parks for drainage of rainwater and canals for drainage of water. In their opinion, this would enhance green infrastructure and provide a stable solution at low cost.

### CONTACT US

**Centre for Ganga River Basin Management and Studies (cGanga)**

Indian Institute of Technology Kanpur, Kanpur 208 016, Uttar Pradesh, India

Email: [info@cganga.org](mailto:info@cganga.org), Website: [www.cganga.org](http://www.cganga.org), Contact No.: +91 512 259 7792

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