Volume: 3 Issue: 4 October 2023

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.

WE AND OUR CITIES AND RIVERS

The balanced mix of land, rivers, mountains, plateaus and plains impart perfection and beauty to our earth. All natural systems existing on this earth are interrelated with one another. But no ecosystem is untouched by human interference in the modern age. The consequences of human interventions on aquatic systems like rivers are clearly visible today and, for restoration of such affected rivers, it is necessary that the diverse ecosystems on land be brought in harmony with aquatic systems. In this issue of Pragyambu, we shall discuss the interrelationship of land and water resources and, through various examples and analyses, try to understand how we can conserve rivers by disciplining our community behavior on land; we will also consider how to avoid flawed human activities that expose us to natural disasters.

According to an ancient saying, a man should live in a place where rivers, kings, doctors, traders and learned men live. Civilizations developed on the banks of rivers everywhere in the world. As civilizations developed, human settlements grew into villages and cities. To meet the needs of our cities, forests started being cleared for farms and industries to be built. Bridges were constructed across rivers for easier transportation. To ensure availability of water throughout the year, rivers were dammed. Thus, cities kept expanding while rivers shrunk. In our world, kings, doctors, traders and scholars all multiplied over time, but rivers went shrinking and drying up. Now we have reached a point wherein the future of our civilization depends on what we do today to keep our rivers healthy and alive.

Generally, when cleaning up or conservion of rivers is talked of, the image of a flowing water stream emerges in our mind. Some of us also participate in river cleaning campaigns on river banks. But this alone is not enough to make rivers healthy and clean. The main stream of a river is only the external form of its body; it is the river and the river basin together that make the river complete. Our activities in the river basin have direct or indirect impacts on the river. If such activities continue in a basin that lead to decline in the river's flow, nirmalta (cleanliness), aviralta (continuity), or the resources required by the river, then cleaning the ghats, beautifying them, or lighting them up will be of no benefit to the river. Let us then try to understand the relationship between a river and its basin, i.e. water resources and land resources, with some examples.

We are aware of the many challenges that our rivers face today. They are drying up and are affected by pollution. On the other hand, if we look at our land resources, the percentage of barren land in the country is increasing. Research conducted by the Space Application Center between 2011 and 2013 revealed that 96.4 million hectares of land in the country is headed towards desertification and barrenness, which is 29.37 percent of the total geographical area. Moreover, as per information released by the Ministry of Rural Development in 2019, the percentage of barren land is increasing in 11 states of the country that include the erstwhile Jammu and Kashmir state, Assam, Telangana, Odisha, Madhya Pradesh and Maharashtra. This is not mere information for its own sake, but a warning of the danger to our future food security. Now let us turn our attention to the third aspect of this very problem, which is the lack of moisture in soil.

Moisture in the upper layer of soil implies water stored in the microscopic pores and empty spaces between soil particles. This water is not visible to the naked eye but its quantity can be measured. The moisture generated by this stored water makes the soil fertile. It is essential for plant growth and the absorption of nutrients by plants. Soil moisture is also necessary for microbial activities and various biochemical processes in the soil (figure 1.). In the last two decades, the problem of diminishing soil moisture has emerged not only in India but also at the global level. Significant declines in soil moisture have been recorded in America, Australia and China. When soil moisture is deficient, the absorption of nutrients in plants is affected, and hence the quality of crops decreases, and gradually the land starts becoming barren. Due to lack

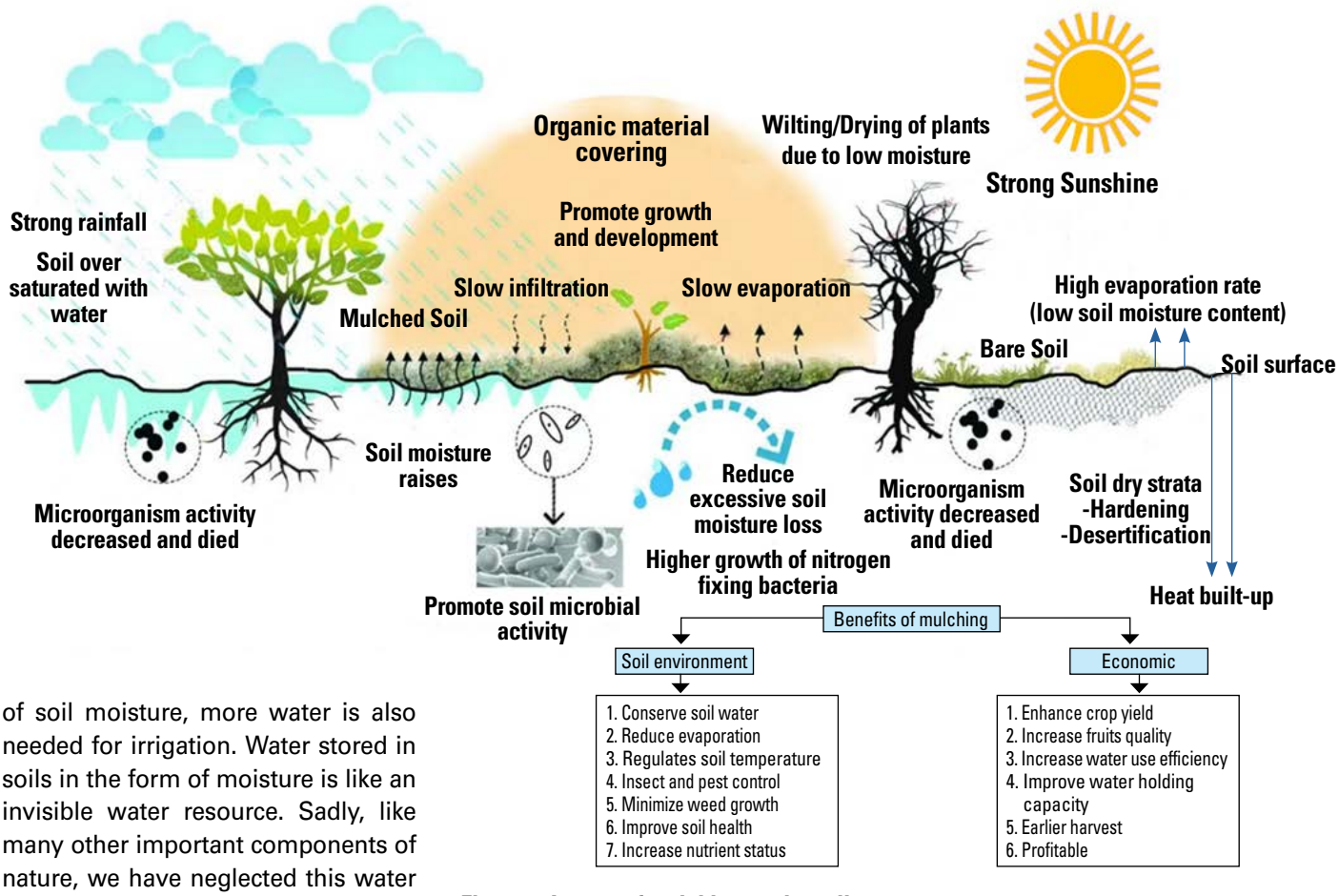

Figure 1. Impact of mulching on the soil ecosystem

of soil moisture, more water is also needed for irrigation. Water stored in soils in the form of moisture is like an invisible water resource. Sadly, like many other important components of nature, we have neglected this water resource, the serious consequences of which are affecting crop yields and will be increasingly seen in future.

There are many reasons for the decrease of soil moisture in modern times, some of which are related to human blunders. For example, arbitrary use of chemical fertilizers and manure increases soil salinity and, when salinity increases, soil moisture decreases. Due to neglect of drains, illegal constructions on drains, etc., the routes of water movement get blocked, and the problem of waterlogging arises. When water does not move freely, then salts in the water accumulate in the soil and increase soil salinity; and, as soil salinity increases, soil moisture decreases, and hence microbial activities get curbed. Due to which the quality of crops becomes poor, while the land gradually becomes barren. Another serious effect of soil moisture decrease is that the rate of carbon sequestration decreases. Carbon sequestration means the return of carbon to the soil. Now, abundance of carbon increases soil fertility. Thus, when the rate of carbon sequestration decreases, soil fertility also decreases. Decrease in carbon sequestration rates means imbalance of the carbon cycle. It is noteworthy that after the oceans, soil is the largest accumulator of carbon. Hence, if the carbon storage capacity of soil declines, dire consequences will result.

In such a situation, the question naturally arises: how can soil moisture be increased?

An easy way to restore moisture in the soil is to apply mulch in agricultural fields. Agricultural wastes like dry leaves, rice straw, sawdust, grass, etc. are spread over the fields as mulch. Due to this type of cover, irrigation water is not lost through evaporation and moisture remains in the soil. In our country, work is ongoing on many innovations for the utilization of agro-wastes. At some places the waste is being converted into energy and at other places into fuel. But the best use of agro-waste is to make mulch in the fields because by decomposition of the waste, soil nutrients return to the soil, water loss is prevented, less water is required for irrigation, and microbial activities in the soil also increase, helping in the maintainenace of soil health and fertility. Apart from this, it is also very important to stop stubble burning completely because, on the one hand burning of stubble increases air pollution, and on the other hand it reduces soil moisture and destroys microorganisms.

To understand the interrelationship between river and land, we have to understand many aspects in detail such as the way land is used.

CHANGE IN LAND USE

To meet the needs of growing populations, the first compromise made is in land use. Grasslands, forests and grazing areas are frequently usurped for residential needs of the settlements, and even

small ponds and lakes are filled up for such uses. Sometimes wetlands and forests are converted to agricultural land. When small ponds, lakes or seasonal streams are eliminated, then the amount of water reaching rivers through land routes decreases, and simultaneously the dependence on big rivers increases for every small and big need. Which means that more water is taken from rivers and in return less water reaches rivers. When forests and plains are converted into residential areas, the absorption rate of rainwater by the land also reduces. On the other hand, if solid and liquid wastes generated from new settlements is not managed and disposed properly, then both types of waste increase the challenges for our waterbodies. An example of change in land use is the Pallikaranai Wetland of Chennai. Fifty years ago this wetland was spread over 6000 hectares, but in just 50 years since then it has been reduced to 600 hectares area due to landuse changes. Such drastic shrinkage of a major wetland in a metropolis like Chennai is due to the urban expansion, unplanned development work, illegal constructions and encroachments. All these factors are said to be the cause of Chennai floods in 2015 which caused the city residents a lot of problems. Other lakes of Tamil Nadu have also shrunk compared to their original size. Vallivakkam Ammattur Lake in Tamil Nadu has shrunk by upto 80 percent of its original size. At some places the waterbodies were filled up due to construction works, and at other places there were illegal encroachments in the lakes. At some places, the water flow routes to the waterbodies were blocked. Similar situations are also seen in other metropolitan cities like Bengaluru, Ahmedabad and Hyderabad. If this be the condition in metropolitan cities, then the situation in smaller cities and towns can be easily imagined. More or less similar things have happened with the wetlands of Kashmir which were spread over 18.75 square kilometers till 1969, but had shrunk to just 13 square kilometers in 2008. Due to reduction in the area of wetlands, some of the basic botanical species found in these wetlands became endangered. Similarly, Kuttanad Wetland and Vembanad Lake located in the central region of Kerala are facing existential challenges. It is noteworthy that Kuttanad Wetland and Vembanad Lake are very important ecosystems of the Western Ghats.

According to a research report released by the International Crops Research Institute for the Semi-Arid Tropics and Swedish University of Agricultural Sciences, the groundwater resources of 12535 hectares area in Hyderabad have decreased by 34.5 percent in the last 11 years. As per the researchers, this is a huge loss in the form of land resource, which will have an adverse effect on the city's climate in future. When the groundwater level falls, there is pressure on any big river of the area to meet the needs of the cities, and drinking water has to be supplied from hundreds of kilometers away in different stages, the cost of which is much higher than supplying water from local sources.

In previous issues of Pragyambu, we had discussed about domestic wastes reaching rivers without proper treatment, thereby stimulating the growth of aquatic vegetation in rivers. Rivers become shallow due to this unwanted growth of vegetation and, during monsoons, when excess water from tributaries and drains reaches the main river, the risk of early flooding increases due to the decrease in depth. Similarly, when people cultivate crops on riverbanks for commercial gain, the roots of the crop hold the soil tight; due to this the silt and soil, which should have flowed down the river or accumulated in the lower regions, gets deposited near the edges of the river. Hence the width of the river gradually reduces, and the risk of disasters like floods also increases.

FLOOD-RAVAGED CITY

One of the reasons for Delhi's floDelhi faced heavy rainfall this monsoon when it recorded 153 mm of rainfall in a single

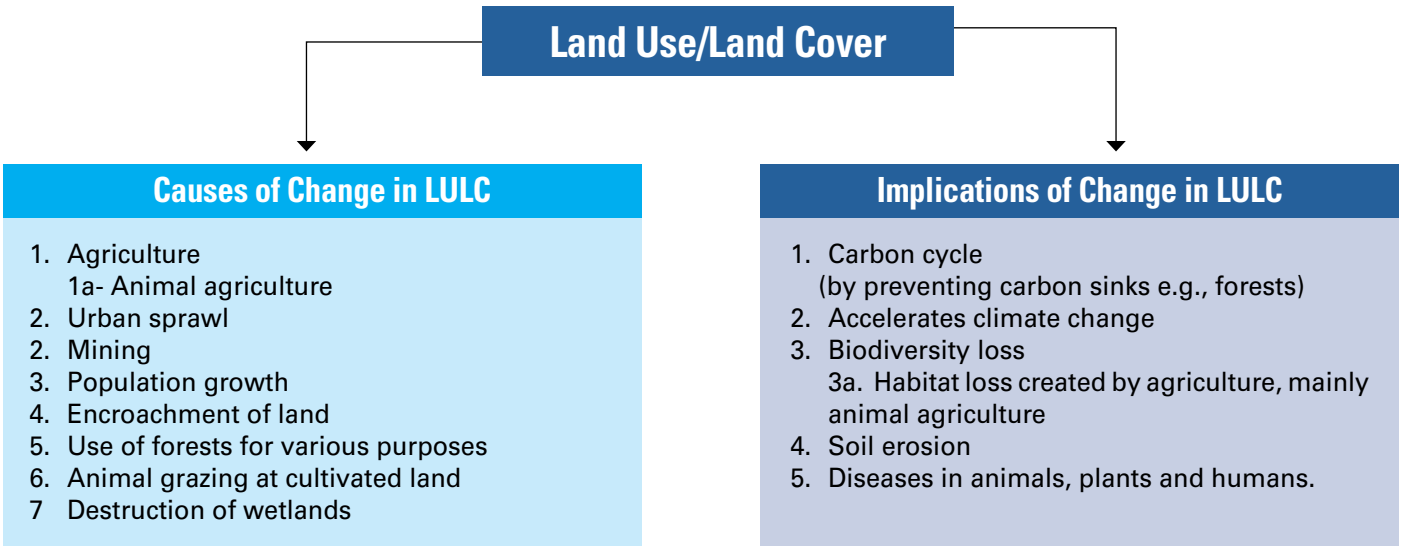

Figure 2. Causes and effects of Land Use/Land Cover change

day. This was the highest single-day rainfall recorded in Delhi since 1982. Due to such heavy rains in Delhi and in the neighbouring states of Punjab, Haryana and Himachal Pradesh, the Sutlej, Ravi, Beas, and Yamuna rivers started flowing above the danger marks and floods occurred. The water level of Yamuna River reached 208.66 meters, which is the highest recorded in the last 60 years, and 41 thousand people were affected with huge losses of life and private and public property taking place. The reason for such heavy rains was said to be obstructions that arose from the west in the path of the monsoon. On the other hand, climate change was also blamed for this dire situation. Climate change can be held responsible for natural disasters like cloud bursts, droughts, floods, etc., but we cannot ignore our own responsibilities by blaming changes in weather and climate. Some of the reasons for the disruption of life during such events are the shortcomings of river and river basin management, which we must acknowledge.

One of the reasons for Delhi's floods is the neglect of the Hindon river, a tributary of Yamuna. According to experts, the width and depth of Hindon has reduced considerably near Delhi. Due to encroachment of water hyacinth in Ghaziabad adjacent to Delhi, the natural depth of Hindon has reduced considerably. When excess water reached Hindon during the rains, the shallowness of the river prevented Hindon from being enriched by this additional water input. Instead, its shallow depth became another reason for the Yamuna floods. Similarly, the neglect of natural drains is also a typical reason for urban floods. Drains are the routes for water flows that effectively manage water movement during rains. Neglect of urban drains is one of the reasons for the devastation caused by floods not only in Delhi but also in Beijing city of China.

According to scientists from Intergovernmental Panel for Climate Change (IPCC), an organization working on climate change, and the Indian Institute of Tropical Meteorology, the recurrence of such incidents (floods, cloud bursts, untimely hailstorms, changes in weather) will increase in the future. We have to develop our basic urban infrastructure in such a way that our cities are ready to face such challenges.

On the subject of Delhi floods, it may be noted that Delhi's drainage system was prepared in the year 1976. Since then the city has expanded a lot. Countless new colonies have come up within and outside the city limits, and the population has increased manifold. If nothing changed in response, it was the city's drainage system. During the recent disaster, this drainage system proved unable to drain the waters out of the city, and rain and flood waters accumulated in many areas as a result.

The second reason for this tragedy in Delhi is the construction on floodplains or what is commonly referred to as alluvium. Floodplains are those areas adjacent to a river, which get submerged during times of abundant water or rainy season. Theoretically, construction work should not be done up to a distance of five kilometers from the river embankments in plains. This restriction had been proposed only to manage the excess water in case of floods, but by avoiding such constructions, damage to property by floods can also be avoided. This directive of no construction in floodplains has been ignored not only in Delhi but also in other cities. When illegal constructions are carried out in floodplains, management of flood water becomes difficult when excess water flows in the river. The width of the river should increase naturally when additional water flows, but such increase gets constrained by constructions. Hence a severe flood situation is created in low-lying areas when excess water flows rapidly in rivers. In both cases, humans suffer losses. Due to construction works in the riverbed, the water absorption capacity of the soil of riparian areas also reduces. The floodplain or alluvial area in Delhi is theoretically 10 thousand hectares, while the length of Yamuna River is 54 km. If the Yamuna's alluvial banks were free from encroachment and illegal construction, it is possible that floods would not have caused such a huge loss of life and property. Delhi had faced flood crises earlier too in 2010 and 2014. The Green Tribunal had also given clear guidelines not to carry out construction work on Delhi's flood affected plains, but many important public construction works have taken place within 5 km range from Yamuna's embankments.

A WORD ON SOLVING OUR PROBLEMS

In modern times, our primary weapon to tackle problems is knowledge. We have a feeling of reverence and devotion towards rivers but remain ignorant of the science of rivers and the region's geography. In a democratic country, land and rivers are public property, and the only way to prevent human interference is through knowledge and awareness. We have to increase our level of awareness about rivers so much that if construction work is seen happening on flood-affected plains, common people should lodge an objection against it with the police or courts. We have to increase public understanding of rivers, water and geology, and increase public participation in the management and control of these resources. On the other hand, various innovations emerging in eco-friendly packaging must be adopted only after examining them thoroughly. If the work of our environmental scientists is not limited to laboratories and research papers but produces knowledge that is applicable in practice, then we can certainly develop a prosperous water-rich and food-rich society.

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