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12. Pristine Ganga Amid Covid-19

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Abstract:

The Ganges/Ganga is the third longest river of India after Indus and Brahamputra rivers. It embarks upon a journey of 2601 km originating in Gangotri glaciers of western Himalayas. This Himalayan River is the most pious river of Hindus who worshipped it as a goddess. It starts its journey from the hilly Garhwal region of Uttarakhand state and enter the plains at Haridwar.From Bijnor it enters into the India's most populated state of Uttar Pradesh covering almost 1450 km distance it enters third Indian state of Bihar at Ara and lastly into West Bengal near Rajmahal before entering Bangladesh and discharging its water into the Bay of Bengal. It not only serves as an economic and spiritual need of the civilians but also is home to many unique flora and fauna. The hydrological cycle in the Ganga basin is dependent on Southwest monsoon. Consequently, stream flow is considered seasonal in the river. This seasonality flow is responsible for both drought and floods in this area. The river is continuously changing course from the past time due to extensive human settlement in the area which keeps on causing havoc in this region regularly. Building of dams and barrages all across the river not only has obstructed the flow of water but also leads to severe water pollution which is posing danger not only to human health but also to fishes, amphibians, reptiles, birds and mammals who are living in it. Ganga is also known for its huge diversity of unique fauna. There are more than 140 species of fishes,90 species of amphibians,27 species of reptiles,315 sp. of birds and one critically endangered and endemic mammal in the south Asian river Dolphin (Platanista gangetica). Some other important animal species facing the verge of extinction and mentioned in Red Data Book which are found in its water are the golden mahaseer fish (Tor putitora), Gharial (Gavialis gangeticus), the northern river terrapin (Batagur baska), three stripped roofed turtle (Batagur dhongoka), red crowned roofed turtle (Batagur kachuga) and Indian skimmer (Rynchops albicollis). According to Central Pollution Control Board, at least 1072 industrial units directly discharge the waste laced with heavy metals and pesticides into the Ganga just between Haridwar and Kanpur. The first step taken by Govt. of India to make river pollution free was way back in 1986 by launching the Ganga Action plan. But it was considered as a huge failure due to many reasons like lack of proper planning and expertise,poor technology and technical support, corruption and lack of stringent laws of enforcement. The lockdown imposed on humans during pandemic COVID-19 has been proved as a boon for the environment. Nature is rejuvenating with air quality improving and rivers getting cleaner. This lockdown of almost 40 days has significantly affected Ganga also which is now looking shimmering and transparent at few areas as the pollution causing factories are shut down and human activities totally ceased. What could not be achieved in last 34 years and by spending 20,000 crores of rupees in Namami Ganga programme was visible in just 35-40 days of lockdown. Though Ganga didn't become pollution free but still 25-30 percent improvement in water quality was noticed.

This significant improvement in water quality parameters like low BOD and high DO, decrease in FCC (Fecal coliform count) clearly indicates that if government takes serious and adequate measures along with strict regulations imposed then in coming days even after the end of lockdown period what we have achieved will be maintained and more initiatives should be taken to make this pristine holy Ganga water fit for drinking again. The reviving of our rivers is not only the need of hour but also doable at the times when world is heading towards world war which is said to be fought for water in future.

12.1 Introduction:

There is no denial in the fact that water plays the most important role in every creature's life that is present on earth. Life on earth is possible owe to the presence of oxygen and water. Earth surfaces consist of 71% water out of which 96.5% is present in oceans which is unfit for drinking. 2.2% of fresh water available on earth surface out of 2.5% is locked in the form of snow in glaciers and at poles while only 0.3% is surface fresh water available for use by living beings is found in rivers and lakes.Water act as a fuel for performing the vital metabolic functions by all living creatures residing on this planet, Earth. Humans need water so that their bodies can function properly. The Panch-Tatva as mentioned in our Vedas are Air, water, fire, earth, and space are considered as the most important elements of life and therefore are considered sacred. They are worshipped with a universal deep feeling of honour in almost all faiths of the world.

Water is believed to be present in two forms:perishable and eternal. Human body consist of 60% water, and this is perishable form of it which disappears when a creature dies while the water recycling through hydrological cycle in nature is the eternal form of it. Water from rivers,lakes,seas and oceans keeps on evaporating continuously and comes back to earth in the form of rain and recharging again and again. Though composition of water varies in human being,an animal or a plant but its essence is same for all. Most religious beliefs the role of "holy" water whose purity is unmatched. The belief has its origin in the minds of people from pre historical time period and unknown mythological origins elevate its importance even further. This divine water is also used as a protection against evil .The use of this holy water known by various name in different faiths like Zamzam water (Muslims), Benitier(Roman catholics), Amrit jal(Sikhism), Mikvah/Mikveh(Jews), Pir-e-sabz(Zoroastrian) and Ganga Jal(Hinduism) for cleansing prior to a baptism and spiritual cleansing is also common.Even in present time of modernization water is still considered as a symbol of purity(both physical and spiritual), fertility and rebirth.

Development of human civilization is the most important role that rivers play. All ancient civilizations evolved around the river banks. The first human settlement occurs in river valleys like ancient Egyptians on the river Nile, Mesopotamia on the river Tigris/Euphrates, Ancient Chinese on the river Yellow and ancient India on the river Indus. Human settlements start appearing roughly around 12000 years ago on the banks of the major rivers.

This settlement around the rivers provides them with fresh water to drink,fertile land to sustain agriculture,fish for food,navigation and transportation also. It also provides a mean of defense and trade. After the wipe out of Harappan civilisation from Indus valley this centre shifted to Ganga valley.

Later the plains of Ganga withstand the test of time and became witness to the rise and fall of powerful states from Mauryan's to Mughal empire. These mighty emperors-built canals in the Gangetic plains for irrigation.

The Ganges canal was built by Britishers from 1842 to 1854 and it was formally inaugurated by Lord Dalhousie in 1854.

Figure 12.1: Goddess Ganga,Source: pinterest.com

In India, the importance of river Ganga is unmatched which occupies the highest place in the socio-cultural ethos of Indians. From times immemorial,the river Ganga is treated with great respect by Hindus. Legend says that King Bhagiratha of Ikshvaku dynasty bought the river Ganga from heaven on earth after doing rigorous penance for long time for the salvation of his deceased ancestors. The flow of Ganga was turbulent and huge due to which Lord Shiva locked her in his hair so that Ganga can safely land from heaven to earth.According to another legend related to Ganga is that Lord Vishnu during his incarnation of dwarf brahmin (Vamana avatar), he took three steps to cross the whole earth and universe and during his second step he accidentally placed a toe on the wall of universe where a hole appears and through which river Ganga comes out and thereby came to known as Vishnupadi. Ganga also found its mention in Mahabharata (Hindu epic) where it is described as mother of Bhishma and wife of King Sanatanu. The importance of Ganga water is mentioned in ancient Hindu scriptures(Puranas) where it has been described as sacred,having magical properties of cleansing all the sins of a person who takes a dip in its holy water and is bestowed with heavenly blessings.Hindus important pilgrimage site (Tirthas) like Gangotri, Haridwar, Prayagraj and Varanasi are situated on its banks. Hindus believe that these tirtha are crossing points between heaven and earth and by visiting these tirthas once in their lifetimes they will be descended to heaven after death.The Ganga is a synonym of faith, devotion and worship for Hindus.

Ganga is depicted as a mother Ganga,a beautiful woman riding the Makra (a creature with the head of a crocodile and the tail of a dolphin)(Figure12.1).Millions of Hindus worship considering her water very pure and believe that even bathing once in it will causes the remission of all their sins.People carry treasured holy and purifying Ganga water all across the country and world and keep it in a vial in their homes. The drop of this water is given to a dying person believing that it would provide him salvation.Ghats or flights of stairs are found all along the banks of Ganga at Varanasi(Uttar Pradesh) and Haridwar(Uttarakhand) where cremation of beloved dead ones and immersion of ashes is done to ensure their safe ride to the other world of their antecedents. Hindus believe that holy water of Ganga or Ganga jal not only purify soul but also liberate the soul from the cycle of life and death(reincarnation). Use of Ganga is pivotal in rituals and for puja (offerings to deities) which pronounce the perpetual nature of the river. During pilgrimage they take drops of Ganga jal in their mouth as they believed it to be the nectar of the Gods. The importance of Ganga and cities situated on its bank can be recognised from the fact that their mention has been found in accounts of Greek traveller and historian Megasthenes as early as 350-290BC. One could easily see the diversity of Indian culture by travelling along its course. Mark Twain's,an American writer quoted in 1890 "Benaras is older than history, older than tradition, older even than legend, and looks twice as old as all of them put together" says all about the importance of the river and towns situated on its banks since time immemorial(Figure12.3). Benaras is also considered sacred by Jain and Buddhist also. The Buddhist people of Thailand celebrates Log 'Krathong festival' to honor Gautama Buddha and Goddess Ganga. They float lit candles into waterways for good fortune and washing away their sins.

The jal(water) of Ganga not only used in rituals but it is also used to meet potable needs(secular role) of the residents through the city's water system. River not only provides sustenance to environment and ecology but also is a support system of 40% Indian population living along its bank and also to the diverse flora and fauna which is found in its water . The river basin is more than 1 million sq km with plains of Ganga as one of the most fertile tracts which accounts for about 47 per cent of the total irrigated area in India(Paul,2017). It also supports highest density of people in the world with 520 person/Km2 and a population of over 650 million people in three countries namely India, Nepal and Bangladesh.Nearly 80% of the Ganga River basin lies in India and the rest in Nepal and Bangladesh(Figure12.2). 43% of India's population lives in Ganga basin which accounts for 26 % of India's mainland.Ganga along with its tributaries form 30% of its water resources. If we consider its entire reach including all small tributaries of the Ganga River,then the basin comprises the parts of 11 states including 236 districts of India's national boundaries. Since ancient times it remains as a source of travel and communication also. The Ganga basin hosts a variety of fish species, including commercially important fishes such as Catla(Catla catla), Indian major carp, walking catfish(Claris batrachus), bronze featherback (Notopterus notopterus), Rohu (Labeo rohita), and golden mahaseer(Tor putitora), murrels etc. (Talwar and Jhingran,1991). 143 fresh water fish species reported out of which 10 are exotic fish species and 29 species were listed under threatened category along with critically endangered Ganges shark(Glyphis gangeticus)(Sarkar et al ,2012). The Gangetic plains are also home to wild Asian Elephants(Elephas maximus), Bengal tiger(Panthera t.tigris), Indian one horned rhinoceros(Rhinoceros unicornis), Sloth bear(Melursus ursinus), four horned antelope(Tetracerus quadicornis), Barasinghas (Rucervus duvauceili).

Bengal Tigers and saltwater crocodile(Crocodylus porosus) are only found in Sunderban delta. Large number of migratory birds are attracted to this region.Out of five true fresh water dolphins of the world,the Ganga River dolphin is one found in its water. The tropical moist decidious forest of Sal (Shorea robusta) are found in upper gangetic plains but due to human settlements and large-scale deforestation in this region only 3% of natural forests are left in this region.

Figure 12.2: The Ganges River course. Source:Maps of India.com

The Ganga is one of the third largest river of India after Indus and Brahmaputra. The Gangotri glacier one of the largest glacier of Himalayas with an elevation of 4000 m above sea level whose terminus resemble a cow's mouth known as Gomukh is the source of Bhagirathi River (tributary of Ganga) which along with river Alaknanda and Mandakini confluence at Devprayag and form sacred Ganga. After flowing speedily for 250 km in the mountains, it descends abruptly to an elevation of 288 m above mean sea level. It enters the plains at Hardiwar and take a long journey of 2,500 km by passing through the three Indian states namely Uttar Pradesh, Bihar and West Bengal before final merging in the sea of Bay of Bengal. The river is fed with melting water from snow of the Himalayan glaciers during April to June while from July to October River is recharged by the rains from South west monsoon. It is joined by various Himalayan rivers known as its tributaries like in upper Ganga basin Bhagirathi, Alaknanda, Ramganga, Ghaghara (largest tributary,1080 km) and Gomati while Yamuna, Tamsa, Sai, Sone, Gandak, Kosi and Damodar in the plains. The Ganga receives more than 60 per cent of its water from its tributaries. A large part of the snow melt water of the Ganga is diverted for irrigation (Upper Ganges Canal)as it enters the plains at Hardiwar. This cause a severe deterioration in its water flow till Kanpur from thereafter it is recharged by its tributaries mainly the Yamuna at Allahabad(Prayagraj). The purity of the water depends on its assimilative capacity and dilution flow of the river.

Most of the tributaries do not contribute much to its pollution load except the Gomati, Damador and Yamuna rivers.

Figure 12.3: Varanasi Ghats ;Source:economictimes.indiatimes.com

The river Ganga is a perennial source of water and plays a pivotal role in the growth of Indian civilization and economy. The river also provides avenues of income for the peoples living on its banks as the cities along the river attract large number of pilgrims and tourists throughout the year. The river is also used by adventure seekers for river rafting and water related sports at Rishikesh. The river Ganga ends at Bay of Bengal and forms the world largest delta. This delta complex is made up of 112 islands out of which only 48 are inhabited. Sunderban delta is home for some endemic, rare and threatened animals like Estuarine crocodile, water monitor, Gangetic dolphin, Olive Ridley turtle, Hawksbill turtle etc. and world's largest mangrove (*Heritiera fomes*) diversity also (Mitra and Zaman,2016; Mitra, 2019). The Maha Kumbh or Kumbh Mela,is the largest religious congregation of humans on earth and which is celebrated after every 12 years on the banks of river Ganga at Haridwar and at confluence of Ganga,Yamuna and invisible Saraswati rivers at Allahabad(Figure12.4&5). This importance and recognition for the Ganga is because people believe that Ganga water owes some naturally beneficial and self-healing properties. In 1972,Sir Seewoosagur Ramgoolam the then prime minister of Mauritius has taken away the holy Ganga water from Gaumukh and mixed it with the water of Grand Bassin in Mauritius renaming it as Ganga Talao for the Hindu population settled in Mauritius.

Figure 12.4&5: Mahakumbh at Allahabad(Source:ndtv.com & fortuneindia.com)

Popular folklore also points towards this unique and mystic properties of river Ganga. There are two major factors which makes Ganga water to qualify as unique. Firstly,it is the self-cleaning property of this river which do not allow water to deteriorate even after several years. The Ganga water is known to contain certain acteriophages(viruses which kill bacteria) due to which Ganga has unique antimicrobial properties. The bacteria's responsible for causing dysentry and cholera i.e Vibrio cholera are killed off naturally preventing its outbreak. The British bacteriologist, Ernest Hankin was pioneer in reporting about this amazing property of the Ganga water against *Vibrio cholera* in 1896 (Hankin,1896). These phages specific to bacterial species plays a key role in making Ganga water pious and non putrifying.

Three types of phages were isolated from Ganga water viz. *Escherichia coli, Salmonella typhii* and *Klebsiella pneumoniae*. This self-purificatory properties in Ganga water is due to its fluidity and presence of some unknown heat-labile peptides that kills the pathogenic *E.coli* (Nautiyal, 2009). It is found to have unusual regenerating capacity which brings down the level of BOD (Biological Oxygen Demand) very fast. Ganga is also found to have various species of bacteria's which excrete certain polymers which helps in removing turbidity of the water by acting as excellent coagulants. It can disintegrate organic waste 15-25 times faster in comparison to any other world's river.Owing so much importance the river gets its due finally and the river Ganga was declared 'The National River of India' in 2008 and the endemic Ganga Dolphin was declared as the 'National aquatic animal' in 2009. Secondly,it is the only river known for highest level of 12 ppm of oxygen and an ability to retain dissolved oxygen 25 times higher than any other river in the world but gradually it is losing this property of oxygen absorption and retention but today this ability has been reduced to 4-8 ppm.

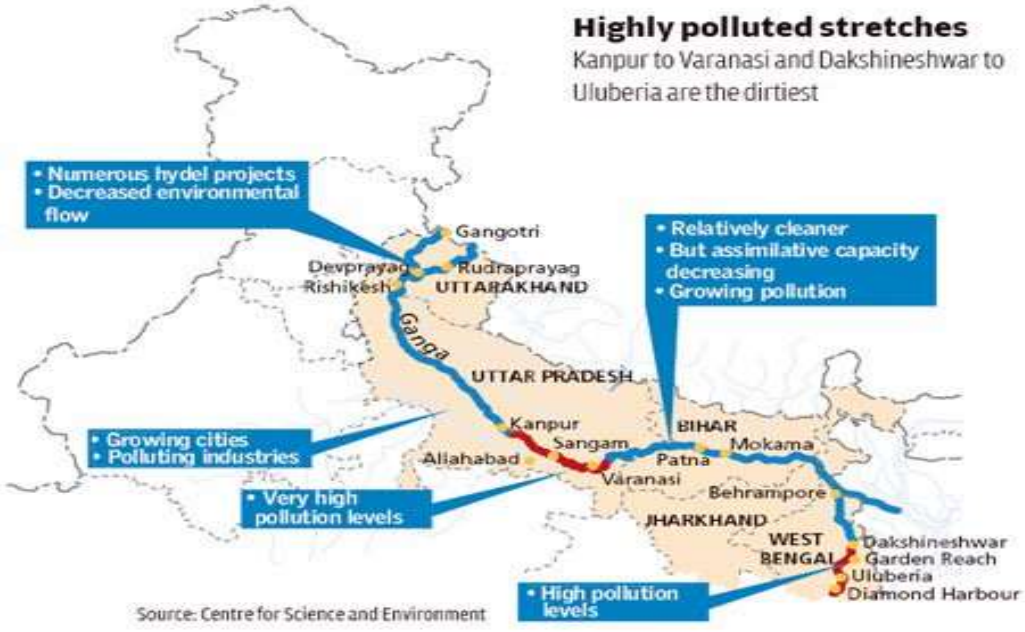

Figure 12.6: Source:Centre for Science and environment

12.2 Ganga Before Lockdown:

India is basically an agrarian country which is now considered as fastly developing country in the world due to its rapid development through urbanization and industrialization. A perennial source of water is a prerequisite for development of urban centres, agriculture, trade and industrialization and the river Ganga qualifies for the same.

Due to change in monsoon patterns and receding glaciers which are source of water to perennial river Ganga and over development in last three to four decades with many small towns situated on its banks have grown to become large cities has caused a havoc. Due to hilly terrain and unavailability of large chunks of flat land in the upper part of Ganga basin pace of industrialization remains comparatively slower in the state of Uttarakhand but at the foothills two major industrial towns are located i.e., Rishikesh to Haridwar known for their drug and heavy electrical industries. Gangetic plain is the most industrialized region of India. Uttar Pradesh is known as "Food Bowl of India" and degraded its 95% of natural vegetation in upper gangetic plain and replaced it with crops like sugarcane,wheat,paddy,chillies etc. Uttar Pradesh is also the highest sugarcane growing state of India and industries based on it like distilleries and sugar mills are mostly found in this region. High population growth and rising per capita income have encouraged farmers for crop diversification. Shift to more water requiring(water intensive) crops like sugarcane,paddy and wheat is putting more stress on both surface and ground water resources and depleting them very fast. The state of Uttar Pradesh in the Ganga River basin area has registered a tremendous increase in gross irrigated area of around 159% during the period of 1962-65 to 2003-2006 along with fertilizer consumption from 1.7 thousand tones per district to a level of 102.6 thousand tonnes during this period(Report by IIT,2011). Kanpur city known as leather city of the world with 80-90% of leather exports and Manchester of the east due to large number of textile industries situated here.Major cities like Patna and Kolkata, in the lower plains and Delta region,are also highly industrialized.

Though considered as the most sacred river the Ganga was unable to prevent its over-use, abuse and pollution. More than 80 per cent of the total pollution mainly comes from homes(domestic sources) along with religious offerings in form of food, leaves, flowers, ashes, bones, half burnt and uncremated bodies, caracasses of cow also contributing to the organic pollution load. Due to over-use of water for irrigation in the upper regions of the river along with the dry weather severely affects the flow of river Ganga. The anthropogenic human activities,changes in landscape and demographic movements have also an impact on river ecology and water quality(Figure12.6). During last few decades there is continuous occurrence of floods, natural disaster/calamities like landslides and cloud burst of 2013 has led to displacement of humans,loss of land, lives and livelihood along with internal migration in the river basin. River has repeated changing its course on its eastern bank(Farakka Barrage,West Bengal). The changing course of the river Ganga along with its tributaries are the source of constant natural disaster every year in the form of floods(in plains) tides and cyclones(in delta region). Both the tributaries of Ganga, the Kosi and Gandak in Bihar are known as 'Sorrow of Bihar' as they cause large havoc year after year during monsoons and changes physical boundaries between states of Bihar and Bengal. The Cyclones and floods are also prevalent in Sunderban area where new islands, streams and river channels keeps on appearing and disappearing. This leads to erosion and avulsion and though avulsion makes the land fertile, but erosion leads to loss of land.

An innumerable land disputes arise due to change in course of Ganga and its tributaries and such disputes are common between the residents of the area as well as between bordering neighbouring countries of Nepal and Bangladesh. During the last hundreds of years, the change in the course of Gandak (tributary of Ganga) known as Narayani in Nepal from east to west has led to border disputes between India and Nepal. Another tributary of Ganga, Tista after the floods of 1787 shifted westward and joined Brahamaputra. Ganga is continuously inclining towards east and Brahamaputra is shifting towards west.

Today, Ganga basin support one third of the country's civic population with 692 towns out of total 2300 located in this basin, and 100 are located along the river bank itself. Along the main river course there are 25 towns with a population of more than 100,000(class 1 cities) 23 towns with populations above 50,000(class 2 cities) and about 50 smaller towns with populations above 20,000(Paul,2017). The state of Uttar Pradesh has 1,000 km of the river's length with mostly all its major urban and heavily industrialized cities situated on its bank. It has 687 grossly polluting industries like that of tannery, textiles, sugar pulp and distillery plants, paper and chemical industries which are contributing 270 MLD of waste water or 70 per cent of the total waste water generated.Out of 100 big industries which are located directly on the river,68 of them are highly polluting. Fifty-five of these industrial units have installed effluent treatment plants (ETPs) and complied with the regulations. The region is also home to the most socio-economically drained(low-income) people who defecate in open on the banks. Taking holy dip or bathing along with other ritualistic practices further enhance its pollution level and put stress on the natural assimilative capacity of the river severely(Figure 12.7).

Figure 12.7: Polluted Ganga Source:indiatoday.in

The quality of water in a river is directly linked with human welfare. Due to its religious importance people take holy dip in its serine water throughout the year and this activity is maximum in summers at Har ki Pauri in Haridwar and Ghats of Varanasi. Though river is lifeline of half a billion people it also earns a status of one of the most endangered rivers of the world due to heavy pollution and poor water flow. Ganga is classified as among the ten world's most endangered rivers by WWF(World Wildlife Fund,2007). Heavy and recalcitrant toxic metals like Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel along with volatile and toxic organochlorate and organophosphate from pesticides,construction related debris also directly dumped into the river(Fig.8).

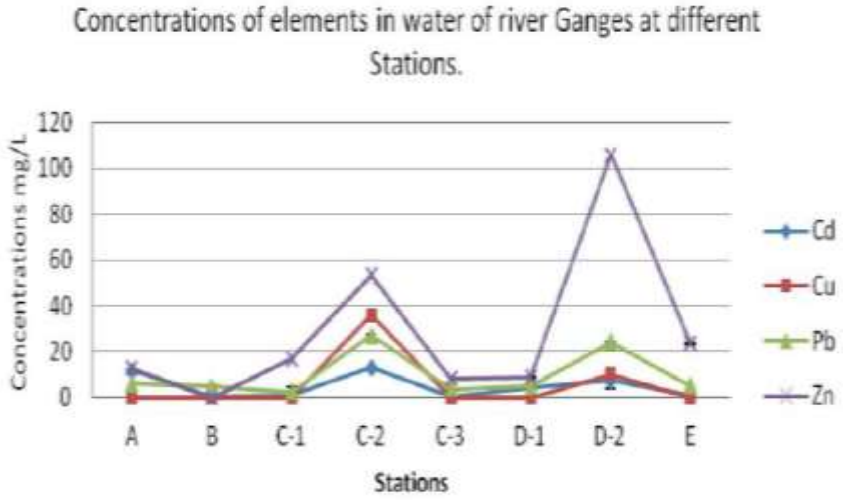

Figure 12.8: Source:researchgate.com

About 12, 222 million litres of domestic and 2500 MLD of industrial waste water which is generated daily is the major cause of pollution in Ganga basin. The Ganga enters U.P.in Bijnor district and passes through most populated and industrialized cities like Merrut, Bulandshahar, Aligarh, Kanpur, Allahabad and Varanasi. Throughout its stretch starting from U.P to West Bengal it violates the drinking water standards. 80% pollution comes from sewage flowing directly from towns and villages and rest 20% by industries. In the middle segment from Kannauj to Varanasi industries like metal industries, textiles, rubber, tannery, paints and pigments,varnishes, paper, steel plants , mining etc. add their effluents directly into the river. By the time river reaches the Kanpur more than 90% of its water is diverted for agriculture and river looks like a drain with concentrated toxic soup. Multipurpose river valley projects were regarded as "The temples of modern India" by Pt.Jawahar Lal Nehru, India's first prime minister considering them important for India's economic development. Dozens of hydroelectric power projects and dam construction started on river Ganga and its tributaries including important ones like Tehri project, Ramganga project, Gandak project, Kosi project, Bansagar, Matatila project, Damodar project etc. Activists and environmentalists claim as many as 940 dams,barrages and weirs are built on river Ganga and its tributaries leading to obstruction in the river's natural flow and blocking the river's arteries upstream. Infact construction of such dams proved to be fast tract destructive projects on our vulnerable river ecosystems.

The Gaumukh Gangotri glacier starting point of the Bhagirathi River which is believed to provide 70% of the river Ganga water in Uttarakhand is retreating 20 meters per year nearly twice as fast as twenty years ago. Intergovernmental Panel on Climate Change(2007) reported that Himalayan glaciers which feeds the river Ganga will disappear by 2035. Due to climate change,decline in rains is further weakening the flow. Huge cracks emerged on the glacier during the natural calamity of 2013 cloud burst which occurred in Uttarakhand. Heavy rains of 2016 have led to the collapse of large chunk of glacier and washing away of front end of Gomukh.Starting from the Bhagirathi upto the Hooghly in Kolkata there are large number of cottage industries running illegaly,dirty brick kilns and thermal power plants dumping out their waste directly into the river. Beside this illegal sand mining has removed away large chunks of sand from both banks and the riverbed. The iconic ghats of Varanasi and Haridwar,the toxic tanneries of Kanpur and north of Kolkata, are the highly polluted expanse of the Ganga. Kanpur is not only the largest city on banks of Ganga but is also a notorious hotspot for polluting its water. There are 442 tanneries in Kanpur contributing 8 per cent of the highly toxic and concentrated waste water. Leather and tanning industries situated here discharge 79 million gallons of effluent per day, exceeding the capacity of municipal treatment facilities(Figure12.9). The 404 units inspected by CPCB , only 23 were found in compliant with the laws of the country.Only 66% polluting industries in Kanpur established sensor-based real-time online effluent monitoring system on the order of Ministry of Water Resources (Del Bello, 2018). Drains discharging into river Ganga contributes BOD load of about 1000 tonnes per day. The sewage treatment plants are either of low capacity or are nonoperational due to lack of electricity or various other factors. According to CPCB(2013) report that 51 of the 64 sewage treatment plants (STPs) were underutilized by 60 per cent of their installed capacity and while 30 per cent were found unfunctional. Most cities along the Ganga do not have any sewage carrying systems. About 300 MLD of industrial effluents (9% of total waste water)is discharged directly into the river every day.

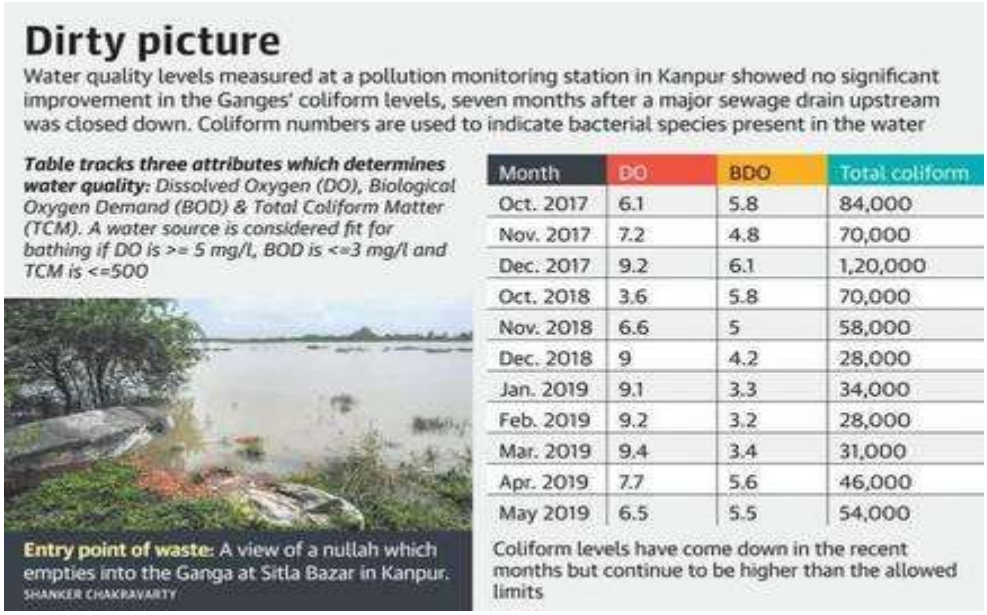

Figure 12.9: Source the Hindu,7.7.2019

The big and most populated cities like those of Kanpur, Allahabad and Varanasi does not have any underground drainage system.

They have open drains which are not connected to STPs and send 70 to 85 per cent of city sewage without any effluent treatment directly into the river. In Allahabad, the seventh most populated city of U.P 57 drains flow directly into the river.Over seven billion litres of raw sewerage are dumped into the Ganga every day from hundreds of big and small towns situated along the river and its tributaries.According to West Bengal Pollution Control Board the state of West Bengal contributes 48% almost half of waste water produced in the Ganga basin and only treats 42% of this .Untreated waste of about 1,779 million litres a day from the 54 drains directly fed into the river. The situation keeps on brimming day by day.Critically polluted points increased from 302 in 2016 to 315 stretches in 2018.Only 7 of 86 live monitoring stations had water fit for drinking after disinfection process and 18 spots out of 80 has water fit for bathing as assessed by CPCB(Central Pollution Control Board,2019). The spots which were found fit for drinking after disinfection(Class A) are Bhagirathi at Gangotri, Alaknanda at Rudraprayag and Devprayag,Raiwala and Rishikesh in Uttarakhand,Bijnor in Uttar Pradesh and Diamond Harbour in West Bengal. The spots which are marked in green indicates that water can be consumed only after disinfection at those places while it is highly polluted throughout its rest of the course and is even unfit for bathing till it drains into the Bay of Bengal(Figure12.10&11).

Figure 12.10, Source: Orissa Post 30.5.19 Ganga water unfit for drinking and bathing(CPCB)

Anthropogenic activities like cutting and cleaning of forests, illegal sand mining, hunting, discharge of heavy metals and lethal chemicals have made Ganga water unfit for drinking and even bathing. Once considered as “Braham Dravya” or divine elixir Ganga water has now become toxin acting like a poison,a noxious mix of heavy metals and chemicals. Groundwater is pumped out extensively for agriculture throughout the basin and recharging of it through water percolating from the river bed has declined significantly leading to drought like conditions now every year during summers. The waste generated by various large- and small-scale industries are directly dumping their waste into the river without any treatment by violating all laws leading to bio accumulation and bio magnifications. These metals accumulate in humans and animal bodies in very high doses leads to undesirable effects on human health.

The Ganga basin is fastly becoming an epicentre for various types of cancers in the country along with retardation in growth and development is also very common in children, various types of infections related to drinking contaminated water like hepatitis, dysentery, diarrhoea, typhoid, cholera, jaundice , skin infection etc. and even death. Water is found to be enriched with variety of strains of various bacterial group which have bactericidal characteristics. The contaminated river water is not only augumenting the risk of various disease but also nurturing the new strains of bacteria's which are antibiotic resistant. Studies done by the National Cancer Registry Programme showed that the regions which are lying downstream of the river course has the highest rate of Gall bladder cancer which is also stands second highest in the world. The other type of cancer which is most prevalent is the prostate cancer which is highest among the men of this part of the country. Besides this cancer of kidney, liver, urinary bladder and skin are also common here. Out of every 10,000 people,450 men and 1000 women were found to have Gall bladder cancer. Varanasi(Uttar Pradesh),Vaishali and Patna(Bihar), Murshidabad and South 24 Pargana(West Bengal) are the hot zones of cancer. Typhoid infection is also prevalent in this region.Over use of pesticides for crop protection in this area further aggravated the situation where these organochlorine rich chemicals lead to oesophageal and stomach cancers. There is 8.47 times higher risk of gall bladder carcinoma with infection from Typhoid(*Salmonella typhii*). Fecal Coliform Count in the Ganga water is at dangerously high level and increase the risk for various water borne diseases like Hepatitis,typhoid,cholera,amoebic dysentry and skin disorders. *S.typhii* isolated from Ganga water were found to possess virulence genes and are pathogenic for humans and animals.WHO(2012)reported that 115,000 people in India loss their life due to water and sanitation related problems. One out of every three deaths in India are related to water borne diseases and 80% of all illness is due to drinking of contaminated water. The world bank estimated that the health costs of water pollution in India is equal to 3% of its GDP.

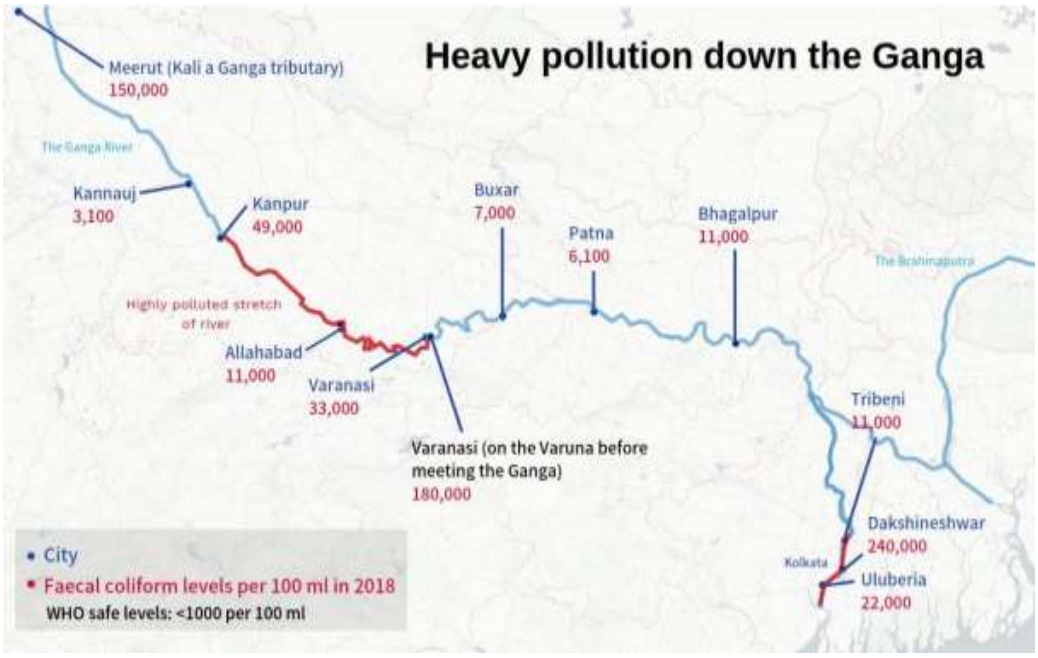

Figure 12.11, Source: thethirdpole.net

Water is considered fit for drinking and bathing according to CPCB standards if it has DO > than 6 mg/litre, BOD < than 2 mg/litre, Total coliform levels <than 5000/ 100 ml and pH should be in range of 6.5to 8.5. The CPCB(Central Pollution Control Board) continuously keep assessing the health of the water of river Ganga.Water quality assessment of the samples collected from Har Ki Pauri(Haridwar) and Ashram Ghat(Rishikesh) from 2007-2011 were found to be positive for *E.Coli* indicating fecal pollution of water.MPN(Most Probable Number) count for *E.Coli* was found to be maximum 450MPN/100ml at Haridwar and 170-230MPN/100ml water at Rishikesh.SPC(The Standard Plate Count) count too ranges from 320-450 SPC/ml×1000 at Haridwar and 150-240 SPC/ml×1000 at Rishikesh(CPCB,2012-2013)(Fig.12). The fecal coliform counts exceed the standard limit < 1000 per 100ml given by WHO.Various bacterias which are found in it includes *Staphylococcus aureus,Salmonella sp.,E.coli,Pseudomonas aeruginosa,Enterobacter aerogenes* and Shigella sp.(Nidhi et al 2015). The discharge of contaminated effluent directly into the river in absence of effective regulatory enforcement by the state pollution control board the water nowhere meets the drinking water quality standards(Figure12.11). The Faecal coliform level was 150,000 at Meerut,180,000 at Varanasi and 240,000 at Dakshineshwar(West Bengal).

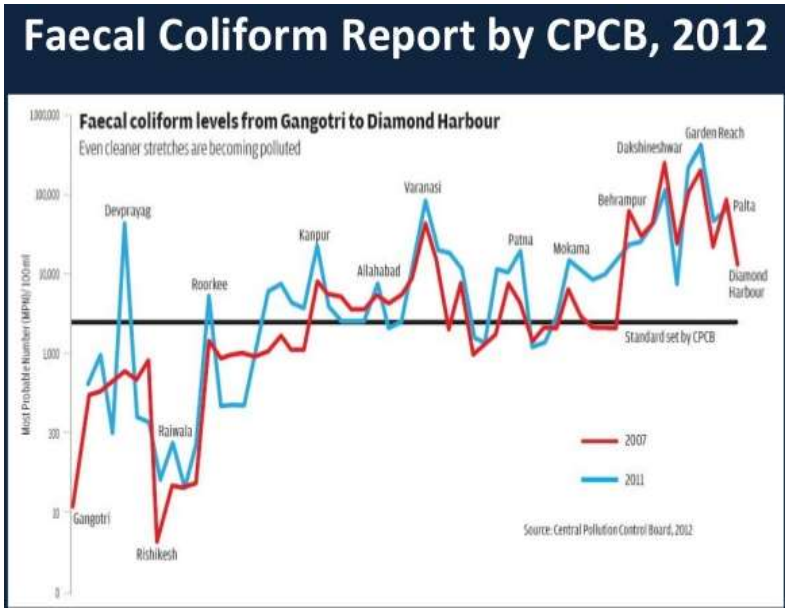

Figure 12.12, Source:slideshare.net

12.3 Ganga During Lockdown:

Rupees 4800 crores were spent on cleaning of Ganga starting from Ganga Action Plan(1986) till 2014. All the attempts failed in making Ganga pollution free whether it is Ganga Action Plan phase 1and 2 or the setting up of National Ganga River Basin Authority(2009). The present Government of India launched another 200 billion-rupee ($3 billion USD) National Mission for Clean Ganga (Namami Ganga Project, 2014) another latest attempt in a long line of failed attempts for not only making Ganga and its tributaries pollution free but also for their rejuvination and conservation. (Dwivedi *et al.,* 2018). World

Bank has also given a loan of $1billion along with Germany($120 million) and Japan (43.755 billion) for the same. The contamination is so high that once known for its crystal-clear water this Himalayan River converted into a cesspool.

The nationwide lockdown not only improved air and water quality but acted as a ventilator for our dying rivers. It seems like that "Coronavirus is Earth's vaccine to save it from human virus". CPCB, a body under the Ministry of Environment, Forest and Climate and Change, recently released a report on April 28,2020 which focused on the impact of the lockdown on the water quality of river Ganga. The report highlighted that due to a decrease in industrial activities and a decrease in domestic waste water, the quality of water in the river has improved. Lockdown leads to fall in pollution levels. The report explains that during the lockdown there is not only significant increase in DO value was but also reduction in nitrate concentration was also seen resulting in overall improvement in water quality of river Ganga. The report also suggested that the absence of industrial waste water discharge, agricultural runoff, and increased fresh flow has further augmented its quality. A decrease in the flow of domestic use of water from as many as 97 towns on the banks of the river has also resulted in an increase in the quality of water. During Lockdown industrial waste stopped entering the river due to their complete shut down along with curtailing of other human activities like tourism, bathing, washing,fairs,religious rituals etc. on ghats led to significant improvement in water quality. Though during this period, the amount of domestic sewage would have increased as people are staying at homes and maintaining hand-wash hygiene also. This improvement in water quality points to the fact that domestic sewage is not the only culprit responsible for deteriorating the quality of water. It has been observed that when sewage and industrial effluents are mixed together,the pollution gets assimilated, and it becomes difficult for river to self-rejuvenate. Another factor contributing to the dilution in pollution is the low level of pesticides running into river as the period was crop harvesting season.

Table 12.1 Source: Central Pollution Control Board (March 28, 2020)

Monitoring Station location	**BOD(mg/l)**	**DO(mg/l)**	**NH_3(mg/l)**	**COD(mg/l)**	**pH**
Ganga Barrage Upstream	2.1	8.0	0.49	<9.0	7.9
Ganga Barrage Downstream	1.21	7.9	1.1	<9.0	7.91
Shuklagunj	2.1	8.51	0.79	<9.0	7.68

According to CPCB data 27 points out of 36 real time water monitoring stations located at different localities on the Ganga River were found suitable for bathing during lockdown. The DO and BOD levels too show significant improvement at Kanpur and Varanasi of river where the DO level showed an increase from 6.5ppm to more than 8 ppm and BOD levels decreased from 4ppm to 3 ppm or even less then that (Table1,CPCB,2020) compared to its level at same time in 2019(Pathak and Mishra, 2020).According to CPCB polluted Nagwa Nala at Varanasi's show the DO value of 6.8mg/l remarkable increase from 3.8mg/l within a month (from 6 March-first week of April).

Ganga water at Haridwar and Rishikesh once again has become fit for 'achaman', which means ritual sipping, after decades showing an extraordinary improvement of 79% in its DO with 50% less sewage and industrial effluents were entering into it.

According to CPCB's on April 19 found that water from middle to lower stretches of Ganga such as Kannauj, Sangam at Allahabad (Table2), bathing ghats at Varanasi bathing ghat 1, Sukartal Ghat, barrage in Kanpur, Fatehpur bridge, Narora, Bhitpur, and Ganga nullah, Murshidabad and Howrah Bridge in West Bengal met the drinking water standards(BOD< 3 mg/l, DO >4 mg/l and pH 6 to 9).

Beside decrease in effluent discharge from factories and seize in human activities on the banks of the rivers like religious offerings, bathing, cremations etc. other natural factors which have contributed to enhancing the quality of the river water is the high and prolonged snowfall in upper reaches of Himalayas and above average rainfall from western disturbances in plains this year which consequently led to decrease in demand for irrigational water and also increased the river flow.

Researchers believe that due to less pollution load and more flow in the river enhance the self-purifying property of river Ganga which in consequence improved the quality of water by 40–50% making it fit for drinking during this lockdown (Hindustan Times, 2020,News18 Buzz, 2020)(Figure12.13).

Figure 12.13: Clean Ganga during lockdown.Source:downtoearth.org.in

The significant improvement in river water quality was also observed in the lower Gangetic delta also. The DO level was found to be significantly increased at Diamond Harbour by 38.54%, Namkhana by 31.73% and Ajmalmari by 12.4%(Sondipon *et al.*,2020). The maximum primary productivity is found in seas and oceans, and which depends on DO level. This increase in DO level in Gangetic delta will not only improve primary productivity but also secondary productivity(e.g Fishery). The lockdown also proved beneficial for the wild flora and fauna in river Ganga.After so many years, the endangered South Asian River Dolphin(Ganga Dolphin)was reported to be spotted by various people at different places of Uttar Pradesh, Bihar and Kolkata(Figure 12.14).

Figure 12.14, Ganga Dolphin spotted at Merrut. Source: IANS 27.4.2020

Table:12.2 Dip in Ganga Pollution at Sangam(Allahabad)

Date	BOD(mg/l)	Total coliform	Fecal coliform
March13	2.8mg/l	3400MPN/100ml	1300MPN/100ml
April 9	2.4mg/l	2600MPN/100ml	820MPN/100ml
April 30	2.3mg/l	2100MPN/100ml	680MPN/100ml

Source: Times of India,21.5.2020

12.4 Conclusion:

Fresh and clean water is vital for human endurance and rivers are precious sources of fresh drinking water for people across the world. The river Ganga is not just a legend but is the identity of 44% Indian population living on its banks.Global pandemic Covid-19 which started in Wuhan, an industrial hub in China and categorized as one of the beta cities of the world has infected more than 16.4 million people of world till date starting from its first report in December 2019. It has killed 630000 people in about 213 countries. Different countries imposed total lockdown ranging from 3-4 weeks to 2-3 months to check the spread of this infectious air borne tiny virus whose only vaccine is social distancing till time known. This lockdown has proved boon in disguise for the environment including all its spheres hydrosphere,lithosphere,atmosphere,and biosphere. Ozone hole started healing itself and so was the mother nature. During this lockdown environmental conditions(air, water) shown such an improvement which was believed to be unachievable for us even after spending crores of rupees just couple of months back. Though the pandemic sends economic shock waves across the globe. The global exports reduced by 4.6% and global GDP by 3.9%(World Bank). Air traffic was drop to 94.1% in April and still started with restrictions. The movement of goods,services and people all came to halt. The Covid-19 has created a feeling of uncertainity about returning to normal in minds of people. The pandemic hit hard the transport and travel industry along with tourism and electronics.

Even after lifting up of the lockdown trade still remains below 90% of its pre-crisis level. Global economic growth is trimmed by 3-6% which could only be partially recovered by 2021 and that too on assuming that there is going to be no second wave of infection in future.Global trade went down by 13-32% with millions of people losing their jobs. Poverty levels increased,careers derailed,mental sickness and depression increasing,social insecurity and unrest prevailing with more than 80 countries closing their borders, business closed, people staying indoors and even the centres of learning closed indefinitely. Several countries are in race of developing the first global Covid-19 vaccine. Different countries are adopting fiscal measures to provide support to different industrial, farm, health care sectors along with providing financial assistance to people of their country according to their ability. According to Global Alliance of Health and Pollution (Dec 2019)7 million people in the world and 2 million people in India die every year from air related problems(WHO, 2018).12.5% of deaths in India is due to air pollution. Among the top 10 polluted cities of world two are in India namely Delhi and Mumbai.WHO declared Covid-19 global pandemic on 11 March and most of the countries in the world imposed total lockdown. The quality of air improved in most polluted cities and dirty green or black coloured polluted water of rivers again become crystal clear fit for drinking and spotted with full of life. Wuhan,the birth place of Corona recorded cleanest February and March air quality during 10-week lockdown. Ten major global cities (Delhi, India; London, UK; LosAngeles,USA; Madrid, Spain; Mumbai, India; New York City, USA; Rome, Italy; Sao Paulo, Brazil; Seoul,South Korea and Wuhan,China) during 3-week lockdown from March23-April 13 show the reduction in PM2.5(Particulate Matter) from 25-60% as compared to the same time period in 2019 with Delhi, Mumbai and Wuhan showed the most. Air quality Index(AQI) improved in all major industrial cities of India(Table3)with Delhi showing improvement of 60-70%, Ahmedabad 37%, Kanpur60%, Talcher 52% and Visakhapatnam 42%.

Table:12.3 Air Quality March Second Week(before lockdown) to April 6(after lockdown)

City	PM 2.5(%drop)	Nitrogen Oxides(%drop)
Delhi	62%	50%
Ahemdabad	57%	32%
Mumbai	45%	60%
Pune	31%	62%

Source: Air Quality COVID Briefing India-GSCC

According to centre for research on energy and clean air on the very first day of lockdown i.e 25 March there was a decrease in PM2 .5 level by 22% and nitrogen dioxide by 15% due to the brakes applied on all modes of transportation which runs on petrol and diesel and on their combustion these harmful pollutants are released.The water of major polluted rivers of the world,river of Mekong(Thailand),the Amazon,the Congo,the Brahamputra,the Ganga during lockdown become fit for use again.According to Karnataka State Pollution Control Board the water quality of Cauvery river reached from C category to A category in this April.

The water of Vembanad lake the longest fresh water lake of India showed improvement in surface water quality. Yamuna Monitoring Committee reported reduction of 1-10% in pH,33-66% in EC(Electrical Conductivity), 51% in DO,45-90% in BOD and 33-82% in COD(Chemical Oxygen Demand) in Yamuna water at Nizamuddin bridge,Okha,Najafgarh drain and Shahdara drain during lockdown phase compared to pre lock down. Any disaster or calamity is considered as a challenge from God to test the human capacity to manage it through truthfulness and righteousness as described in our ancient Indian scriptures the Rigveda and Atharvaveda.

So is the challenge posed by Covid-19 for our policy makers and government to plan strategies and formulate mitigative measures as what we are not able to achieve in so many decades by launching so many projects for cleaner Ganga was achieved in lockdown period of 1-2 months.Keeping in mind the economic interests of a country and its people the lockdown cannot be imposed forever. Neither the industries can be shut down for infinite time nor the vehicular movement can be restricted.

The lesson we learn during this time is to become a more responsible and the uncontrolled and destructive human activities against nature responsible for degradation of environmental ecology and biodiversity must be curbed so that rivers like Ganga, Yamuna, Cauvery which were respiring on lockdown ventilator can be bought back to life. It is high time to restore the river's "**aviralta**" uninterrupted flow to insure its "**nirmalta**"(cleanliness). It is a known fact that when river changes it course it leads to the vanishing of the civilization. At present the lockdown imposed throughout the world to contain Corona virus spread has proven as a nature's vaccine to restore its ecosystem and environment. The environmental degradation which is caused by humans since the start of industrial revolution was reversed in a period of just 1–2 month.

This is a signal for us to understand the nature's call and be responsible in future. There is urgent need of controlling point sources of pollution along with enforcement of strict laws for environment protection not only in papers but also in realty. Public participation and technical advancement for the management and disposal of solid waste generated during agricultural practices and from homes is also need of an hour. The International Water Resource Management Institute has predicted that due to rapid industrialization and growth in population will lead to 32% increase in national water demand by 2050. It is high time to check pollution of surface water as well as groundwater along with proper implementation of water conservation measures otherwise it could lead to a Cape Town-like situation.

Indian cities already started facing such situation with Chennai the fourth largest urban city of India declared Day Zero on 19 June,2019. "**Pavan guroo,paanee pitaa maataa dharat mahat**"is a saying in Sri Guru Granth Sahib,the holy book of Sikhs that says Air is our guru(teacher), water our father, and great earth is our mother.

These resources are gift of God and God resides in them. If we harm them, we disrespect the almighty. We should consider them sacred. Secondly one should live in thankfulness and give due regards to the mother nature for its bounty of gift's which it bestowed on us . So it is not only the responsibility of the government but also of the people to act wisely and use these resources judiciously and sustain ably.

12.5 References:

1. CPCB. (2013). Pollution Assessment: River Ganga. Ministry of Environmental and Forests.
2. Del Bello, L. (2018). Indian scientists race to map Ganges River in 3D. Nature, 560(7717), 149-149.
3. Dwivedi, S., Mishra, S., Tripathi, R.D. (2018). Ganga water pollution: A potential health threat to inhabitants of Ganga basin. Environment International, 117, 327-338.
4. Hankin,E.H.(1896).L'action bactericide des eaux de la jumma et du Gange sur le vibrion du cholera.Ann Inst Pasteur,10,511-523.
5. HindustanTimes2020.Anxiety-more-time-to-study-for-40k-students-stranded-in-Kota.www.hindustantimes.com/india-news/anxiety-more-time-to-study-for-40k-students-stranded-in-kota/story-LgCluBkrFEITG9qyX16IEI.html Retrieved from: [Google Scholar]
6. Mitra,A.2019.Estuarine Pollution in the lower gangetic delta.Published by Springer International publishing.ISBN 978-3-319-93305-4,XVI,371.
7. Mitra,A and Zaman,S.(2016).Basics of Marine and Estuarine Ecology.Published by Springer International publishing.ISBN 978-81-322-2707-6.
8. Nautiyal, C. (2009). Self-purificatory Ganga water facilitates death of pathogenic *Escherichia coli* O157: H7. Current microbiology, 58(1),25-29.
9. Nidhi Singh Chauhan,Manjul Dhiman(2015).Assessment of microbial diversity of river Ganga at Haridwar and Rishikesh.International Journal of Scientific Research, 4(11),393-396.
10. News18 Buzz.(2020).Ganga River Water Has Now Become Fit for Drinking as Industries Remain Shut Due to Lockdown. https://www.news18.com/news/buzz/ganga-river-water-has-now-become-fit-for-drinking-as-industries-remain-shut-due-to-lockdown-2575507.html Retrieved from: [Google Scholar]
11. Paul, D.(2017).Research on heavy metal pollution of river Ganga: A review. Annals of Agrarian Science. 15(2),278-286.
12. Pathak, S.S., Mishra, P.(2020). A review of the Ganga River water pollution along major urban centres in the state of Uttar Pradesh, India. Int. Res. J. Eng. Technol. 7(3):1202–1210. [Google Scholar]
13. Sarkar,U.K., A.K.Pathak,A.K.Pandian,A.Pandey, V.K.Dubey, and W.S.Lakra.(2012). Freshwater fish biodiversity in the river Ganga(India):changing pattern,threats and conservation perspectives:Rev Fish Biol.Fisheries.22:251-272
14. Sondipon Chakraborty, Ankita Mitra, Prosenjit Pramanick, Sufia Zaman and Abhijit Mitra.(2020). Scanning the water quality of lower Gangetic delta during COVID-19 lockdown phase using Dissolved Oxygen(DO) as proxy. NUJS Journal of Regulatory Studies, Special Edition, pp 61-66.
15. Talwar,P.K. and A.G.Jhingran(1991).Inland fishes of India and adjacent countries. Volume1& 2A. Oxford and IBH Publishing Co.Pvt.Ltd, New Delhi.