Most ancient civilizations grew along the banks of rivers; even today millions of people all over the world live on the banks of rivers and depend on them for their survival. One river might have its source in a glacier, other in a spring or in a lake. Rivers carry dissolved minerals, organic compounds, small grains of sand, gravel and other materials as they flow downstream. Rivers begin as small streams, which grow wider as smaller streams and rivers join them along their course across the land. Eventually they flow into seas or oceans.

The Ganges is one of the major rivers of the Indian subcontinent, flowing through the Gangetic plain of northern India into Bangladesh. The river, primarily known as Bhagirathi, rises on the southern slopes of the Himalayan ranges from the Gangotri glacier at 4000 m. above mean sea level. It flows swiftly for 250 km. in the mountains, descending steeply to an elevation of 288 m. above mean sea level. In the Himalaya region, the Bhagirathi is joined by the tributaries, Alaknanda and Mandakini to form the Ganga. After entering the plains at Haridwar, it winds its way to the Bay of Bengal, covering about 2510 km. (1560 mi) through the provinces of Uttar Pradesh, Bihar and west Bengal. In the plains it is joined by Ramganga, Yamuna, Gomati, Ghaghara, Sone,
Gandak, Kosi and Damodar along with other smaller rivers. In central Bangladesh it is joined by the Brahmaputra and Meghna rivers. Their combined waters (called the Padma river) empty into the Bay of Bengal and form a delta 220 mi (354 km) wide, which is shared by India and Bangladesh.

Its plain is one of the most fertile and densely populated regions in the world. The Ganges alone drains an area of over a million square km with a population of over 410 million. Millions depend on water from the river for several things: drinking, bathing, agriculture, industry and other household chores.
The Ganga has also been important historically: many former provincial or imperial capitals such as Patliputra, Kannauj, Kara, Allahabad, Murshidabad and Calcutta, have been located on its banks. The Ganges basin drains 1,000,000-square-kilometre (390,000 mi) and supports one of the world’s highest densities of humans. The average
depth of the river is 52 feet (16 m), and the maximum depth, 100 feet (30 m). The many symbolic meanings of the river on the Indian subcontinent were spoken to in 1946 by Jawaharlal Nehru in his discovery of India.

The Ganges, above all over is the river of India, which has held India’s heart captive and drawn uncounted millions to her banks since the dawn of history. The story of the Ganges from her source to the sea, from old times to new, is the story of India’s civilization and culture, of the rise and fall of empires, of great and proud cities, of adventures of man. Although many small streams comprise the headwaters of Ganges, the six longest headstreams and their five confluences are given both cultural and geographical emphasis. The Alaknanda River meets the Dhauliganga River at Vishnuprayag, the Nandakini River at Nandprayag, the Pindar River at Karnaprayag, the Mandakini River at Rudraprayag, and finally the Bhagirathi River at Devprayag, to form the mainstream of Ganges. The Bhagirathi is the source stream; it rises at the foot of Gangotri glacier, at Gaumukh, at an elevation of 3,892 m (12,769 ft). The headwaters of the Alakananda are formed by snowmelt from such peaks as Nanda Devi, Trishul, and Kamet.

The Ganges River, also known as mother Ganges, is revered as a goddess whose purity cleanses the sins of the faithful and aids the dead on their path towards heaven. Hindus have long believed that the water of
Ganga has a unique property of purity. Studies conducted in 1983 on water samples taken from the bank of the Ganga at Patna, confirm that Escherichia coli, Faecal streptococci and Vibrio cholerae organisms, die two to three times faster in Ganga than in water taken from the other rivers like Sone, Gandak, from dug wells and tube wells in the same area. In most Hindu families, a vial of water from the Ganga is kept in every house. It is believed that drinking water from the Ganga with one’s last breath will take the soul to heaven. Hindus also believe life is incomplete without bathing in the Ganga at least once in their lifetime. Some of the most important Hindu festivals and religious congregations are celebrated on the banks of the river Ganga such as the Kumbh fair and the chhat puja. Kumbh mela is the largest religious gathering on earth for Hindu peoples. Over 100 million Hindus from all around the country participated in the last Kumbh mela at the Hindu holy city, Haridwar.

The upper Ganges supplies water to extensive irrigation works. The river passes the holy bathing sites at Haridwar, Allahabad (where the Yamuna river enters the Ganga), and Varanasi. Below Allahabad the Ganges becomes a slow, meandering stream with shifting channels. Joined by numerous rivers such as the Kosi, Sone, Gandak and Ghaghra, the Ganges forms a formidable current in the stretch between Allahabad in Uttar Pradesh and Malda in West Bengal. On its way it passes the towns of Kanpur, Soron, Kannauj, Allahabad, Varanasi, Patna, Ghazipur,
Bhalapur, Mirzapur, Ballia, Buxar, Saidpur, and Chunar. At Bhagalpur, the river meanders past the Rajmahal hills, and begins to run south.

**Fig. ii – LOCATION MAP OF INDIA SHOWING GANGLA RIVER**

At Pakur, the river begins its attrition with the branching away of its first distributary, the Bhagirathi-Hooghly, which goes on to form the Hooghly River. Near the border with Bangladesh the Farakka barrage, built in 1974, controls the flow of Ganges, diverting some of the water into a feeder canal linking the Hooghly to keep it silt-free.

According to Hindu religion a very famous king Bhagiratha did tapasya for many years constantly to bring the river Ganges, then residing
in the heavens, down on the earth to find salvation for his ancestors, who were cursed by a seer. Therefore, Ganges descended to the earth through the lock of hair (jata) of god Shiva to make whole earth pious, fertile and wash out the sins of human. During the early Vedic ages, the Indus and Saraswati rivers were the chief rivers, not the Ganges. But later, the three Vedas seem to give much more significance to the Ganges, as shown by its plentiful references. Possibly the first westerner to mention the name of Ganges was Megasthenes.

Ganga River is also said to be the river of supreme lord Rama and also called “Ram-Ganga” as there is a belief that Lord Rama promised while Ganges emerged from his feet that, when he will appear on earth as Lord Rama will reside on the banks of Ganga and her tributaries. Lord Rama then appeared in Ayodhya which is on the banks of Saryu Ganga River, when he went to Janakpuri he crossed river Ganga in Haridwar. During his 14 years exile from Sita, his wife and brother Lakshmana after leaving Ayodhya his first night stay was at Tamsa river (The Ganga tributaries), his second stay was at shrungverpur which is on the bank of Ganga and with the help of Nishadraj Gruh and Kevat he crossed Ganga, he then went to Triveni Sangam, Prayagraj stayed with muni Bharadwaj and then marched towards Chitrakoot and stayed there for 11 and half years on Kamadgiri parvat on the banks of Mandakini, holy stream. From there he went to Panchvati and stayed on the bank of Godavari until his
wife Sita was abducted by demon king Ravana. The search for his
beloved wife Sita, lord Rama went to Rameshwaram,

The mighty Ganga is not only the River but much more to the
millions for whom the Ganga is a symbol of faith, hope substance and
sanity. Therefore the Prime Minister Manmohan Singh declared on
November 4, 2008 that henceforth the Ganga would be known as India’s
‘national river’.

The Prime Minister has also announced the proposal to set up a
high powered Ganga River Basin Authority to stop its pollution and
degradation. Chaired by the Prime Minister, the authority would have as
the members the chief ministers of states through which the river flows,
besides working closely with ministers of water resources, environments
and forests, urban development and others as well as agencies working on
river conservation and pollution management.
However, despite the natural resilience of the Ganga, the alarming high volume of pollution poses an ever increasing threat to the health and life of the river. Because of its location near major population centers, however, the river is highly polluted. The Ganga collects large amounts of human pollutants as it flows through highly populous areas. These
populous areas, and other people downstream, are then exposed to these potentially hazardous accumulations.

The Ganga basin is the home to over 300 million people, out of which about 30 million live in densely polluted cities situated directly along its banks. Most of the urban centers lack proper sewage treatment facilities. Almost 88% of the pollution originates in 29 cities located along its banks. The industrial pollution accounts for about a quarter of the whole problem. It is by no means insignificant since most of it is concentrated in specific areas and the effluents are more hazardous. The state of Uttar Pradesh alone is responsible for over 50% of the pollutants entering into the river along its entire journey to the sea.

The principal sources of pollution in Ganga are domestic and industrial wastes. Conservative estimates put the effluents flowing into Ganga is approximately 1.7 billion liters each day out of which 1.4 billion liters is untreated. Domestic and industries pollution combined with deforestation, use of pesticides, insecticides, fertilizers, and other factories, have rendered the water of Ganga unfit for drinking or bathing.

Today, over 29 cities, 70 towns, and thousand of villages extend along the Ganga banks. Nearly all of their sewage, over 1.3 billion liters per day goes directly into river, along with thousands of animal’s carcasses, mainly cattle’s. Another 260 million liters of industrial waste are added to this by hundreds of factories along the rivers banks.
Municipal sewage constitutes 80 percent by volume of the total waste dumped into the Ganga, and industries contribute about 15 percent. The majority of the Ganga pollution is organic waste, sewage, trash, food, and human & animal remains. Over the past century, city populations along the Ganga have grown at a tremendous rate, while waste-control infrastructure has remained relatively unchanged.

Recent water samples collected in Varanasi revealed Faecal-coliform counts of about 50,000 bacteria per 100 milliliters of water, 10,000% higher than the government standard for safe river bathing. The result of this pollution is an array of water-borne diseases including cholera, hepatitis, typhoid and amoebic dysentery. An estimated 80% of all health problems and one-third of deaths in India are attributable to water-borne diseases.

The sacred practice of depositing human remains in the Ganga also poses health threats because of the unsustainable rate at which partially cremated cadavers are dumped. In Varanasi some 40,000 cremations are performed each year, most on wood pyres that do not completely consume the body. Along with the remains of these traditional funerals, there are thousands more who cannot afford cremations and whose bodies are simply thrown into the Ganga. In addition the carcasses of thousands of dead cattle, which are sacred to Hindus, go into the river each year. An inadequate cremation procedure contributes to a large number of partially
burnt or unburnt corpses floating down the Ganga. Gray dust from the pyres float atop the waves, mixing with flower garlands and foam. The dust and debris resurfaces some distance away, this time intermixed with polythene bags, empty cans and dirty clothes. This is the holy Ganga at its holiest spot, Varanasi.

The industrial pollutants are also a major source of contamination in the Ganga. A total of 146 industries are reported to be located along the river Ganga between Rishikesh and Prayagraj. 144 of these are in Uttar Pradesh (U.P.) and 2 in Uttarakhand. The major polluting industries on the Ganga are leather industries, especially near Kanpur, which use large amount of chromium and other toxic chemical waste, and much of it finds its way into the meager flow of the Ganga. From the plains to the sea, pharmaceutical companies, electronics plants, textile and paper industries, tanneries, fertilizer manufacturers and oil refineries discharge effluents into the river. This hazardous waste includes hydrochloric acid, mercury and other heavy metals, bleaches and dyes, pesticides and polychlorinated biphenyls, highly toxic compounds that accumulate in animal and human tissue.

The tannery industry mushrooming in north India has covered the Ganga River into a dumping ground. The tannery industry discharges different types of waste into the environment, primarily in the form of liquid effluents, containing organic matters, chromium, sulphide
ammonium, and other salts. As per an estimate, about 80-90% of the tanneries use chromium as a tanning agent. The hides take up only 50-60%, while the rest is discharged as effluent. Pollution becomes acute when tanneries are concentrated in clusters in small area like Kanpur. However in 1996, the Supreme Court has banned the discharge of effluents from various tanneries and factories located on its banks in Kanpur, still the effluent are being thrown into the river by these industries.

However, industry is not only the source of pollution, Sheer volume waste-estimated at nearly one billion liters per day-of mostly untreated raw sewage is also a significant factor. Runoff from farms in the Ganga basin adds chemical fertilizers and pesticides such as DDT, which is banned in the United States because of its toxic and carcinogenic effects on human and wildlife. Damping the river or diverting its water, mainly for irrigation purposes, also adds to the pollution crisis. Atmospheric deposition of heavy metals emitted from vehicles and presence of industrial units adjoining the Ganges are adding the pollution load on the river.
TABLE i. - WATER QUALITY STANDARDS FOR OUTDOOR BATHING
(CLASS B)

<p>| | |</p>
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</thead>
<tbody>
<tr>
<td>pH</td>
<td>6.5-8.5</td>
</tr>
<tr>
<td>Dissolved Oxygen (DO)</td>
<td>5 mg/l or more</td>
</tr>
<tr>
<td>Biological Oxygen Demand (BOD)</td>
<td>3 mg/l or less</td>
</tr>
<tr>
<td>Faecal Coliform</td>
<td>500 MPN/100 ml (Desirable)</td>
</tr>
<tr>
<td></td>
<td>2500 MPN/100 ml (Max. Permissible)</td>
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</tbody>
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Discharge of untreated wastewater from towns along Ganga constitutes the major source of pollution load for the river. Against the estimated wastewater generation of around 3000 million liters per day (mld) from towns along the river Ganga, sewage treatment capacity of 1025 mld has been created so far under the Ganga Action Plan. This information was given by the minister of state for environment and forests (independent charge) Shri Jairam Ramesh in Rajya Sabha on August 02, 2010. Decades-long efforts by the government to breathe life into Ganga through massive clean-up programmes have come to naught. Over 1,000 crores have been pumped into the Ganga action plan 1st and 2\textsuperscript{nd} between 1985 and 2000, but India’s holiest river is still polluted.
India is endowed with rich water resources. Approximately 45,000 km long riverine system criss-crosses the length and breadth of the country. These rivers include Himalayan snow fed rivers, peninsular rain fed rivers and coastal short rapids. The total geographical area of 3.29 million square km of the country has been divided into 12 major river basins, 46 medium river basins and 14 minor and desert river basins. The major river basins account for 78% of total surface area and serve 80% of the population. The Ganga river basin is the largest of these, extending over the states of Uttarakhand, Uttar Pradesh, Haryana, Himachal Pradesh, Delhi, Bihar, Jharkhand, Rajasthan, Madhya Pradesh, Chhattisgarh and West Bengal.

Rapidly increasing population, rising standards of living and exponential growth of industrialization and urbanization have exposed the water resources, to various forms of degradation. The deterioration in the water quality of the river impacts the people immediately. Many Indian rivers, including the Ganga in some stretches, particularly during lean flows, have become unfit even for bathing. Realizing that the rivers of the country were in a serious state of degradation, a beginning towards their restoration was made with the launching of the Ganga Action Plan in 1985. It was envisaged as a comprehensive programme of river conservation with the objective of improving the water quality. It was
visualized that in due course, the programme would be enlarged to cover other major rivers of the country.

In order to prepare such a major programme, an exhaustive study titled “Assessment and Development Study of River Basin Series” (ADSORBS) of the Ganga Basin was carried out by the Central Pollution Control Board (CPCB). The study covered all aspects of rivers in the Ganga basin including water quality. The study pointed out that besides pollution from municipal and industrial wastes, non-point sources like runoff from rural settlements, pesticides from agricultural fields, open defecation, dumping of carcasses and disposal of dead bodies significantly contribute to pollution of the river and render the water unsuitable for its intended use. Equally important is the issue of flow in the River. Dams and barrages for storing and diverting water for irrigation, domestic consumption and industry affect the flow, particularly during dry months. This has serious implications for water quality and aquatic life in the river.

The Ganga Action Plan Phase I (GAP I) was started in 1985 to improve the water quality of river Ganga to acceptable standards by preventing the pollution load reaching the river. The main focus of the Plan was on interception, diversion and treatment of municipal sewage draining into the river, which accounted for about 75% of river pollution. Treatment capacity of 869 million liters per day (MLD) was created in 25
Class-I towns in the three States of Uttar Pradesh, Bihar and West Bengal. In addition to the core works relating to sewerage and sewage treatment, certain non-core works like afforestation, crematoria, low cost sanitation and river front development, were also taken up. Under GAP I, only a part of the pollution load of river Ganga was addressed. Therefore, the Plan was extended to GAP II, which was approved in stages between 1993 and 1996. Besides Ganga, GAP II included its major tributaries viz. Yamuna, Gomti and Damodar. Subsequently, Mahananda was also added. 59 towns along the main stem of river Ganga in the 5 States of Uttarakhand, UP, Bihar, Jharkhand and West Bengal are covered under GAP II. A sewage treatment capacity of 130 MLD has been created under the Plan. In response to demands from many States, the Ganga Action Plan was expanded in 1996 to the National River Conservation Plan (NRCP) to include other rivers in the country. Presently polluted stretches of 36 rivers in 20 States are covered under NRCP. The Himalayas are the source of three major Indian rivers namely the Indus, the Ganga and the Brahmaputra. Ganga drains a basin of extraordinary variation in altitude, climate, land use, flora and fauna, social and cultural life.

**GANGA ACTION PLAN-1(GAP 1)**

Under GAP I, pollution abatement schemes were taken up in 25 Class-I towns in three States of U.P., Bihar and West Bengal. GAP I was
declared complete on 31.03.2000 with an expenditure of Rs. 452 crores.

The details are given below:

States Covered - 3 (UP, Bihar and West Bengal)
Towns Covered - 25 (UP-6, Bihar-4 and West Bengal-15)
Schemes Sanctioned - 261
Schemes Completed - 260
Interception and Diversion - 88
Sewage Treatment Plants - 34
Low Cost Sanitation - 43
Crematoria - 28
River Front Development - 35
Others (Afforestation) - 32
Sewage Treatment Capacity to be Created - 882 MLD (35 STPs)
Sewage Treatment Capacity Created - 869 MLD (34 STPs)
Total expenditure incurred - Rs. 452 Crores

GANGA ACTION PLAN PHASE II (GAP - II)

As GAP I addressed only a part of the pollution load of Ganga, GAP II was launched in stages between 1993 and 1996. 59 towns along the main stem of river Ganga in five States of Uttarakhand, U.P., Jharkhand, Bihar and West Bengal are covered under the Plan. The salient features of the Plan are asunder:
States Covered - 5 (Uttarakhand, UP, Bihar, Jharkhand and West Bengal)

Towns Covered - 59 (Uttarakhand-10, UP-12, Bihar-13, Jharkhand-1, and West Bengal-23)

Schemes Sanctioned - 319

Schemes Completed - 200

Sewage Treatment Capacity to be Created - 277.28 MLD (37 STPs)

Sewage Treatment Capacity Created - 129.77 MLD (18 STPs)

Ganga basin is the largest river basin in India in terms of catchment area, constituting 26% of the country's land mass (8,61,404 Sq. km) and supporting about 43% of its population (448.3 million as per 2001 census). The basin lies between East longitudes 73°30 and 89° 0 and North latitudes of 22°30 and 31°30, covering an area of 1,086,000 sq km, extending over India, Nepal and Bangladesh. About 79% area of Ganga basin is in India. The basin covers 11 states viz., Uttarakhand, U.P., M.P., Rajasthan, Haryana, Himachal Pradesh, Chhattisgarh, Jharkhand, Bihar, West Bengal and Delhi. The annual average rainfall in the basin varies between 39 cm to 200 cm, with an average of110 cm. 80% of the rainfall occurs during the monsoon months i.e. between June and October. Because of large temporal variations in precipitation over the year, there is wide fluctuation in the flow characteristics of the river.
Bhagirathi is the source stream of Ganga. It emanates from Gangotri Glacier at Gaumukh at an elevation of 3,892 m (12,770 feet). Many small streams comprise the headwaters of Ganga. The important among these are Alaknanda, Dhauliganga, Pindar, Mandakini and Bhilangana. At Devprayag, where Alaknanda joins Bhagirathi, the river acquires the name Ganga. It traverses a course of 2525 km before flowing into the Bay of Bengal.

In Uttarakhand, near Tehri, a dam has been built on Bhagirathi for hydropower generation resulting in regulated additional water during the dry months. At Haridwar, Ganga opens to the Gangetic Plains, where a barrage diverts a large quantity of its waters into the Upper Ganga Canal, to provide water for irrigation. At Bijnaur, another barrage diverts water into the Madhya Ganga Canal but only during monsoon months. At Naroura, there is further diversion of water into the Lower Ganga Canal. Further down, River Ramganga joins Ganga near Kannauj, adding additional water to the river. Yamuna confluences Ganga at the Sangam in Allahabad, making a major contribution to the river flow. Beyond Allahabad, Ganga is joined by several tributaries, most of which are from the north and a few from the south. In the stretch between Allahabad in U.P. and Malda in West Bengal, Ganga, therefore, has considerable flow. The Farakka barrage in West Bengal regulates the flow of the river, diverting some of the water into a feeder canal linking Hooghly to keep it
relatively silt-free. Downstream of this barrage, River Ganga splits into two, Bhagirathi (Hooghly) on the right and Padma on the left. Bhagirathi (Hooghly) meets the Bay of Bengal about 150 km downstream of Kolkata. Padma enters Bangladesh and meets river Brahmputra and Meghna before finally joining the Bay of Bengal.