NEXT IAS

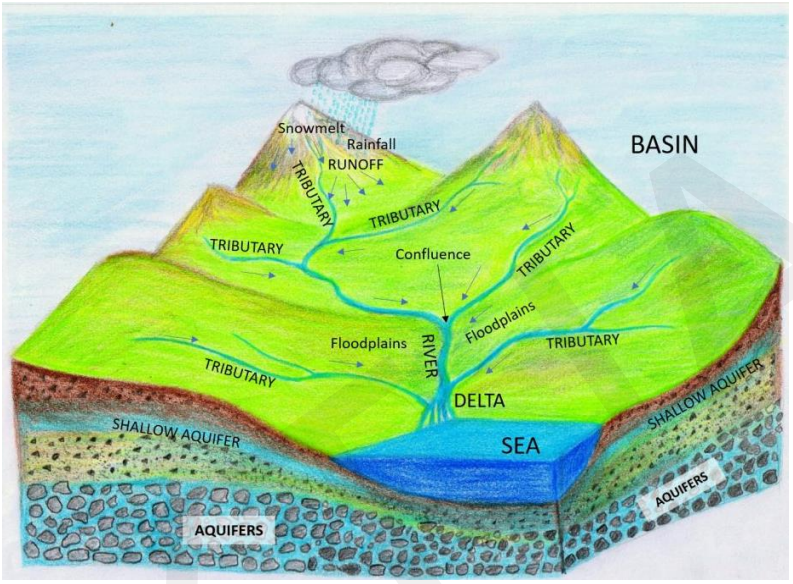
GEOGRAPHY

INDIAN DRAINAGE SYSTEM AND RIVER SYSTEM

Indian Drainage System

INTRODUCTION/BASICS

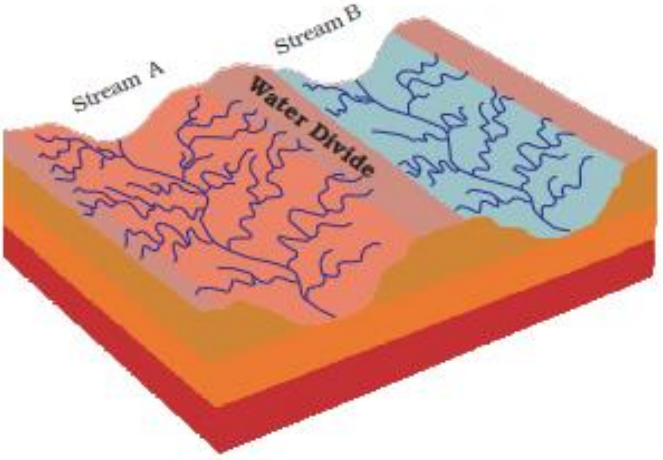
- Rivers originate from high land areas like mountains, plateaus, hills and travels through low land area in direction of slope and further it flows towards sea
- Sources of river water primarily rainwater and sometimes glaciers melting, springs also Water percolating in the ground forms part of groundwater.
  - This ground water comes out on the surface as springs. The main source of groundwater is rainwater.
- Rivers cut mountains and make deep valleys.

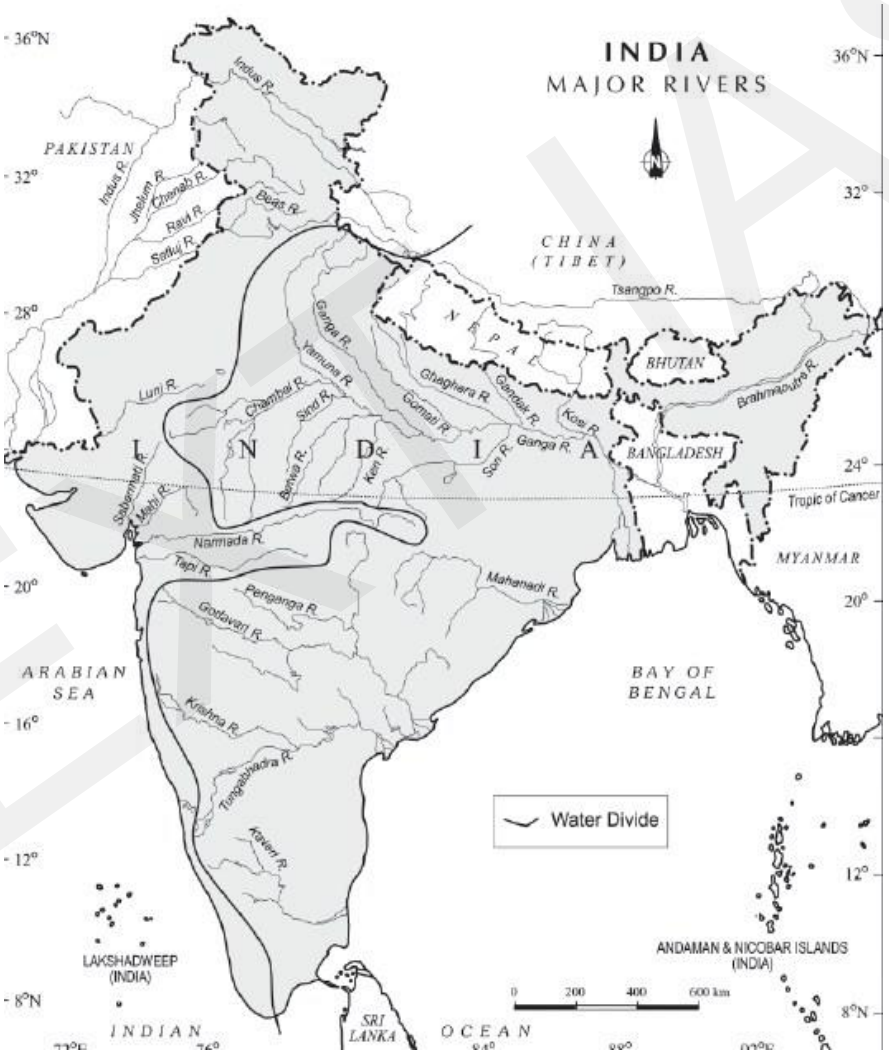


- Water streams which join the mainstream/river during its course are called the tributaries.
- A river drains the water collected from a specific area, which is called its 'catchment area'. An area drained by a river and its tributaries is called a drainage basin.
- River during its course accumulates sediments, boulders, pebbles etc with it. As it moves over low land areas it drops the heavier objects. Further near the mouth of the river it drops finer sediments forming the deltas.
- A river drains the water collected from a specific area, which is called its 'catchment area'
  - An area drained by a river and its tributaries is called a drainage basin.
- The basic difference between a river basin and a watershed is that watersheds are small in area while the basins cover larger areas
- A river delta is a landform created by deposition of sediment that is carried by a river.
- Water divide or drainage divide:
  - It is an elevated area, such as a mountain or upland that separates two drainage basins. Such an upland is known as a water divide.

WATER DIVIDE OF INDIA

- The drainage systems of India are mainly controlled by the broad relief features of the subcontinent. A mountain or an upland which separates two drainage basins in an elevated area is known as a water divide.
- The major water divides of India are Western Ghats, Satpura, Vindhyachal and Aravalli mountain ranges. In this water divides rivers flow from both sides of the highland area.
- This water divide of India in general divides the Indian rivers into East and West flowing rivers.





What is Watershed?

- The boundary line separating one drainage basin from the other is known as the watershed.
- The catchments of large rivers are called river basins while those of small rivulets and rills are often referred to as watersheds.
- There is, however, a slight difference between a river basin and a watershed.
    - Watersheds are small in area while the basins cover larger areas.

DIVISION OF INDIAN DRAINAGE SYSTEM

Indian drainage system may be divided on various bases:

On the basis of discharge of water

The rivers in this category may be grouped into:

- the Arabian Sea drainage
- the Bay of Bengal drainage

The above mentioned drainage systems are separated from each other through the Delhi ridge, the Aravallis and the Sahyadris.

Nearly 77 percent of the drainage area consisting of the Ganga, the Brahmaputra, the Mahanadi, the Krishna, etc. is oriented towards the Bay of Bengal while 23 percent comprising the Indus, the Narmada, the Tapi, the Mahi and the Periyar systems discharge

their waters in the Arabian Sea.

On the basis of the size of the watershed

The rivers in this category may be grouped into:

- Major river basins with more than 20,000 sq. km of catchment area.It includes 14 drainage basins such as the Ganga, the Brahmaputra, the Krishna, the Tapi, the Narmada, the Mahi, the Pennar, the Sabarmati, the Barak, etc.
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INDIAN RIVER/DRAINAGE SYSTEM BASED ON ORIGIN

- The Indian rivers are generally classified on the bases of their origin. It has two broad classifications:
- The Himalayan Rivers: these rivers are perennial in nature
- The Peninsular Rivers: these rivers are non-perennial in nature.

Comparison between the Himalayan River System and the Peninsular River System:

Himalayan Rivers	Peninsular Rivers
1. Himalayan rivers originate from the Himalayan mountains covered with glaciers.	1. Peninsular rivers originate from the Peninsular plateau and central highland.
2. Main source of water—Glacier, Rainwater, springs	2. Main source is Monsoon Rain.
3. Himalayan rivers are perennial in nature	3. Peninsular rivers are seasonal in nature
4. Volume and speed of water are more than the Peninsular river.	4. Volume and speed of water are less than Himalayan river. Therefore, disputes are more here.
5. Due to this large area in Northern India is flood prone and floods occur frequently.	5. Floods occur occasionally.
6. Drainage pattern- antecedent and consequent.	6. Drainage pattern- trellis, radial and rectangular drainage pattern.
7. Have a longer course	7. Shorter Course
8. Flow through the rugged mountains and	8. Less Erosion in the present time and a shallow valley.
	9. Hard Rock structure and a Straighter

experience headward erosion and forms deep valley and Gorges 9. Sedimentary structure and have meandering and shifting of course. 10. High Hydroelectric and Irrigation potential 11. Navigation potential for transportation is very high.	course. 10. Low Hydroelectric and irrigation potential 11. Low navigation potential because of the seasonal nature of rivers.

Antecedent or Inconsequent Drainage: The rivers that existed before the upheaval of the Himalayas and cut their courses southward by making gorges in the mountains are known as the antecedent rivers.

Consequent Rivers: The rivers which follow the general direction of slope are known as the consequent rivers.

HIMALAYAN RIVER SYSTEM

These rivers originate in the Himalayan and Trans- Himalayan region. The Himalayan drainage consists of several river systems. The three major rivers systems of Himalayas are namely:

- Indus River System
- Ganga River System
- Brahmaputra River System

Indus River System

- It covers areas of 4 countries India, Pakistan, Tibet(China), Afghanistan.
- In India, the Indus basin spreads over the states of Jammu & Kashmir, Himachal Pradesh, Punjab and a part of Rajasthan, Haryana, and Union Territory of Chandigarh, having an area of 3,21,289 sq. km, which is nearly 9.8% of the total geographical area of the country.
- The Indus rivers originate in Bokhar chu glacier near mansarovar lake in Kailash mountain (Kailash mountain is an extension of Karakoram) and is nearly 3000 Kms long.
- In Tibet it is called Singhi Khamban which translates to Lions mouth.
- It flows in between Ladakh and Zaskar mountain ranges and passes through the Leh area. Further it goes to Gilgit Baltistan area and here it creates Indus George (near Nanga Parbat) before entering Pakistan. This Gorge is 5Km deep and is the deepest gorge of India.
- The Indus river is an antecedent river and is older than the Himalaya, therefore it forms deep Georges.
- From Afghanistan Kabul river joins the Indus in Pakistan.
- Indus river drains into the Arabian Sea near the port city of Karachi, Pakistan after forming a huge delta

Tributaries of Indus River:

In Ladakh:

- Shyok- originates in Siachen Glacier. It flows through Ladakh and enters Gilgit Baltistan area
- Nubra—originates from the Siachen glacier, and joins Shyok.
- Galwan---originates in Galwan area and joins Shyok
- Hunza- It cuts through the Karakoram range and flows through Pakistan .
- Gilgit- originates in Gilgit area.
- Zanskar - forms through the confluence of two small rivers - Doda River and Tsarap river. It runs through Ladakh Plateau. It joins the Indus in Ladakh.

MAJOR TRIBUTARIES OF INDUS RIVER:

Jhelum River

- It originates from Verinag spring in Pir Panjal mountain range of Kashmir valley.
- It merges into Chenab in Pakistan
- It passes through Srinagar and Wular lake (one of the largest fresh water lake in India)
- Tributary - Kishanganga (Neelum in Pakistan) river merges with Jhelum in Pakistan
- Major Projects -
    - Kishanganga project
    - Tulbul Navigation Project

Chenab River

- It originates in Himachal Pradesh near Bara Lacha pass in Lahaul Spiti valley
- Its source tributaries are Chandra and Bhaga. The confluence of Chandra and Bhaga streams is called Chenab
- It flows through Jammu & Kashmir valley in between Pir Panjal and Greater Himalayas and after entering Pakistan it joins Jhelum.

- Chenab river is the largest tributary of Indus
- Major Projects-
    - Baglihar project
    - Dulhasti project
    - Salal project
    - Projects under construction- Pakal Dul dam, Rattle Project, lower Kalnai project-all this in J&k, while Miyar project in Himachal Pradesh.

River Ravi

- It originates in Himachal Pradesh near north of Rohtang Pass
- Passes through Ludhiana(Punjab), Lahore(Pakistan)
- It flows through the Jammu region and then enters Punjab. It passes through Ludhiana(Punjab) and finally enters Pakistan.
    - The Kartarpur corridor lies in Pakistan's Narowal district across the Ravi River Gurdaspur Dera Baba is located on Indian side and Kartarpur Sahib on the Pakistan side.
- Major Projects:
    - Thein dam or Ranjeet Sagar dam - on border of Punjab and Jammu
    - Shahpur Kadi in Punjab
    - UJh project in Jammu

Beas River

- It originates in Himachal Pradesh, south of Rohtang pass.
- It flows through Kullu, Manali and then enters Punjab and meets Satluj river at Harike Barrage in Punjab.
- It flows completely in India.
- The Indira Gandhi canal starts from Harike barrage. It is the longest irrigation canal of India. It runs upto Rajasthan and irrigate the Thar desert area
- Barrage is a smaller structure just to divert water while a dam is used for many purposes.
- Major Projects:
    - Parvati dam in Himachal Pradesh
    - Pong dam in Himachal Pradesh

River Satluj

- It originates in Tibet, Rakas lake south of Mansarovar in Kailash range.
- It enters Himachal Pradesh at Shipki la pass and joins Beas river in Punjab. After joining Beas river, it enters Pakistan.
- Major Projects:
    - Bhakra (HP) and Nangal(Punjab) dam- It is the 2nd highest dam in India. The water reservoir behind the Bhakra Dam is known as Gobind Sagar.
    - Nathpa Jhakri dam in Himachal Pradesh - It is a run-off river project.

The term Punjab means the land of 5 rivers. Punjab is formed from the sediment deposits of the five rivers of the Indus river system.

There are mainly 5 Doabs in Punjab:

- Bist Doab - between Satluj and Beas rivers
- Bari Doab - between Beas and Ravi rivers
- Rachna Doab- between Ravi and Chenab rivers
- Chal / Jech Doab - between Chenab and Jhelum rivers
- Sindh Sagar Doab -between Jhelum and Indus rivers

INDUS WATER TREATY

- In order to optimize water efficiency, a treaty was signed with Pakistan in the year 1960 and was named Indus Water Treaty.
- The treaty was brokered by the World Bank.
- The treaty divided Rivers into western rivers and eastern rivers.
- Under this treaty, the waters of the three eastern rivers (the Ravi, the Beas and the Sutlej) would be for the exclusive use of India and waters of the three western rivers (the Indus, the Jhelum and the Chenab) for the exclusive use of Pakistan.

Salient features of the treaty:

- The treaty has no provision for either country unilaterally walking out of the pact and the provision of treaty provides that it shall continue in force until terminated by a duly ratified treaty concluded for that purpose between the two governments.
- The treaty also provides for appointment of Permanent Indus Commission which meets regularly at least once a year, alternately in India and Pakistan and a permanent post of Commissioner for Indus Waters.
- It also provides for information sharing between the two nations on a regular basis.
- There have been some instances where India has threatened to withdraw from the treaty. Even if India abrogates the treaty, nothing would change on the ground. In terms of water availability for Pakistan, it would continue to receive the flows till India plans and completes its storage and/or water diversion projects.
- Any action by India to abrogate the treaty will prove, legally or diplomatically inappropriate and against acknowledged international conventions.

The China factor

- Moreover, India cannot ignore the China factor as both major rivers originate in Tibet. India does not have a treaty with China pertaining to this.
- China is also supporting Pakistan's claim over the river issues.

GANGA RIVER SYSTEM

The Ganga is the most important river of India both from the point of view of its basin and cultural significance.

Origin and Course of River

- It rises in the Gangotri glacier near Gaumukh (3,900 m) in the Uttarkashi district of Uttarakhand.
- Near the origin the river is known as the Bhagirathi. It cuts through the Central and the Lesser Himalayas in narrow gorges
- It is the largest river system in India covering around 26 percent of India.

- It covers around 2525 kms from source to mouth.
- Bhagirathi meets Alaknanda river at Devprayag and it is then called Ganga river.
- Ganga river basin covers the area of Uttarakhand, Uttar Pradesh, Bihar, Jharkhand and West Bengal.

About Alaknanda River:

- The source of Alaknanda River is the confluence of Satopanth Glacier and Bhagirathi Kharak Glacier.
- The length of the river is 190kms.
- Many tributaries join the main stream of Alaknanda River
    - Dhauliganga meets Alaknanda at Vishnuprayag
    - Nadakini meets Alaknanda at Nandprayag
    - Pindar meets Alaknanda at Karnprayag
    - Mandakini meets Alaknanda at Rudraprayag

MAJOR TRIBUTARIES OF GANGA RIVER

Yamuna River

- It originates at Bandarpunch glacier in Uttarakhand.
- It flows through Uttarakhand, Himachal Pradesh, Haryana, Delhi, Uttar Pradesh and joins Ganga at Prayagraj in Uttar Pradesh.
- It forms a natural state boundary between UK-HP, UK-Haryana, UP-Haryana, UP-Delhi.
- Major Project:
    - Project Satluj Yamuna link canal: It is the bone of contention between Punjab and Haryana. SC ruled in favour of Haryana. But due to the water crisis in Punjab, it rejected an agreement to transfer water to Haryana.

Ramganga River

- It originates in Pauri Garhwal in Uttarakhand. It is left bank tributary of Ganga
- It Passes through Jim Corbett park and enters Uttar Pradesh at Kannauj.

Gomti River

- It originates in Pilibhit region, and completely flows in Uttar Pradesh
- It flows through Lucknow city, Jaunpur and meets Ganga at Gazipur, Uttar Pradesh.

Ghaghara

- It originates from south of Mansarovar lake in Tibet then it passes through Nepal and finally enters India through UP and flows through Bihar.
- It is second longest tributary of ganga
- It joins with Ganga in Chhapra district of Bihar.
- It is also called Sarayu River on the bank of which Ayodhya is located.
- Tributaries –
    - Sharda (It is called as Kali or Mahakali at Uttarakhand Nepal Border from Milam Glacier) and
    - Rapti River (It is on eastern side of Gharghara/ It is famous for Gorakhpur)

Gandak

- It originates in Nepal and enters UP and joins Ganga at Sonpur in Bihar
- In Nepal it is known as Narayani.
- Gandak river is the international boundary and eastern part of the river belongs to India and western part of the river belongs to Nepal.
- Susta region adjoining Gandak in West Champaran region lies along this river banks. It is a disputed region between India and Nepal.

Kosi

- It originates in Tibet close to Tibet- Nepal border. Then it passes through Nepal, India (Bihar) and joins Ganga in katihar district of Bihar.
- It is called the Sorrow of Bihar as it causes massive floods and changes its course frequently.
- Although it causes floods, it brings new alluvium every year in floods.
- It is also called Sapta Koshi in Nepal as it is made of various rivers like sun Kosi, Tamur Kosi, Arun kosi etc.

Son

- It is a Peninsular River and originates in Amarkantak region in Madhya Pradesh.
- It passes through MP, UP, Jharkhand and Bihar.
- It is right hand tributary of ganga and joins ganga near Patna (Bihar)
- Tributaries –
    - Rihand River (UP): A dam has been built on this river known as Rihand dam.
    - North Koel River: It originates from Chota Nagpur Plateau and flows through Jharkhand and Bihar

Mahananda

- It originates from Darjeeling hill area in West Bengal and flows through West Bengal, Bihar and finally to enters into Bangladesh
- It enters Bangladesh and Joins Padma River
- Tributary: Mechi river in Nepal and joins Mahanada in India

Burhi Gandak

- It flows in Bihar only between Gandak and Kosi
- Bagmati river from Nepal is tributary of this river

Damodar River

- It is also a Peninsular River
- It passes through Chotanagpur Region i.e Jharkhand and West Bengal.
- It is called Sorrow of Bengal as it caused floods in the past.

First Multipurpose River valley project of India on River Damodar was launched in 1948 to control floods and use water for various other purposes- hydropower, flood control, irrigation, Navigation. It was called Damodar Valley Corporation. This model was taken from the USA on the lines of Tennessee River Valley Authority (TVA).

A series of Dams were constructed on Damodar River. Important ones are –Tilaiya, Maithon, Barakar.

It was a very successful project but the project has become less relevant recently due to sedimentation of the dam and reduction in flow of river. Dredging is required at regular intervals.

MAJOR TRIBUTARIES OF YAMUNA RIVER:

These rivers are part of Ganga basin but not tributaries of Ganga.

Chambal

- It originates at Janapav, south of Mhow town, on the south slope of the Vindhya Range in Madhya Pradesh.
- It is famous for Critically endangered Gharials
- It passes through MP, Rajasthan and UP.
- There are many important dams on this river. Some of them are: Gandhi Sagar Dam in MP, Jawahar Sagar Dam in Rajasthan, Rana Pratap Sagar Dam in Rajasthan.

Sindh

- The river originates from the hills of Jhansi and Tikamgarh district of Uttar Pradesh.

Betwa

- It originates in Vindhya Range just north of Hoshangabad, Madhya Pradesh. It flows generally northeast through Madhya Pradesh and Uttar Pradesh states

Tons

- Joins Yamuna in Uttarakhand

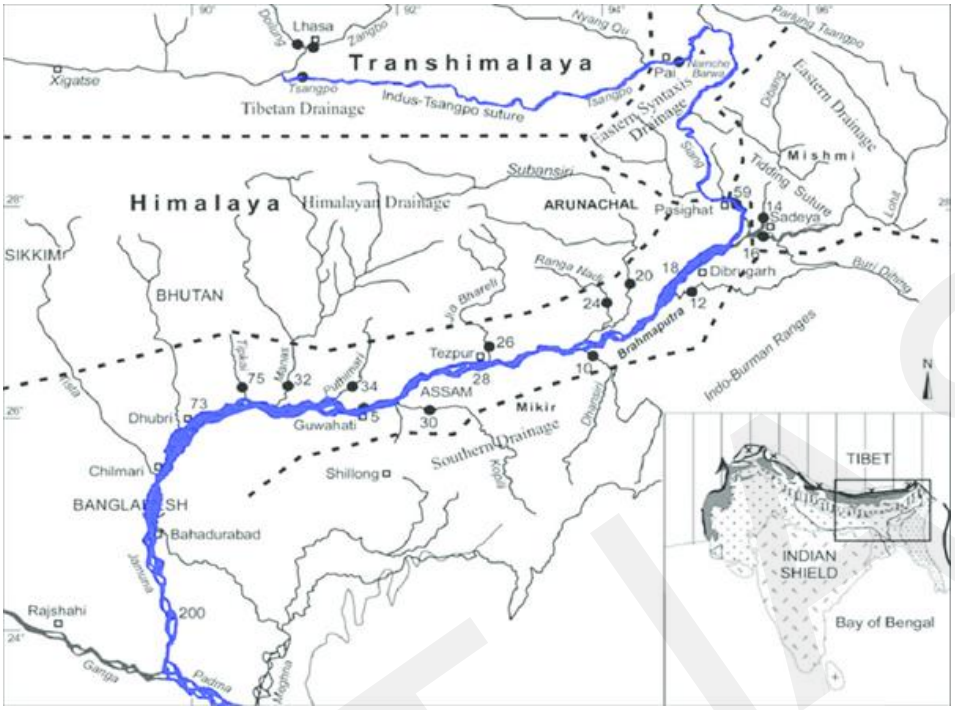
Hindon

- It joins Yamuna in Ghaziabad (UP)

Ken

- It originates near Jabalpur District of Madhya Pradesh.
- It passes through Bundelkhand region
- Ken and Betwa have been in News in recent times due to the Ken Betwa Link Project as it is the first river link project under interlinking of rivers.

BRAHMAPUTRA RIVER SYSTEM



- The Brahmaputra, one of the largest rivers of the world.
- It originates in Tibet region from Chemayungdung glacier as per British but as per Chinese its source is Ancsi glacier.
- It enters India from Arunachal Pradesh. Then it flows in Assam and then flows in Bangladesh and falls in Bay of Bengal.
- It is the largest river of India due to its volume of water.
- Its total length is around 3000 km. It is longer than Indus and Ganga.
- It runs eastward but at Namcha Barwa it cuts Himalayas and forms a gorge valley called Dihang Gorge. From here it turns westwards. It takes U-turn here to avoid mountains
- In Tibet it is called Tsangpon or Yarlung Zangbo
- In Arunachal Pradesh it is called Dihang/ Siang. In Assam it is called as Brahmaputra
- In Bangladesh it is called Jamuna. After it joins Padma then the river is known as Padma. After meeting with Meghna it is known as Meghna. It is Meghna which empties itself in the Bay of Bengal.

Tributaries of Brahmaputra

- Major tributaries of Brahmaputra are Sankosh, Manas, Kameng, Subansiri, Dibang, Lohit, Burhi Dihing, Kopili.

Teesta

- It originates from Zemu glacier in Sikkim and flows to West Bengal and Bangladesh. Rangit River is a tributary of Teesta in Sikkim.
- There is an issue over sharing of water of Teesta River. It is used for hydropower generation e.g. Teesta Project

Raidak

- It originates in Central Bhutan and enters West Bengal and then Bangladesh. It makes a boundary between Assam and West Bengal. India constructed two dams on this river in Bhutan-Chukka and Tala.

Sankosh

- It originates in Bhutan and then passes through Assam and joins Brahmaputra.

Manas

- It originates in Tibet then flows through Bhutan, Arunachal and Assam. It is famous for Manas National Park.

Kameng

- It originates in Arunachal Pradesh and flows in Assam where it joins Bangladesh. In Assam it is called Jia Bharali.

Subansiri -

- It originates in Tibet and enters India in Arunachal Pradesh and flows through Assam to join Brahmaputra.
- Lower Subansiri project is under construction on Arunachal – Assam Pradesh border.

Dibang /Sikang

- It originates in Arunachal Pradesh and flows in Assam where it joins Brahmaputra at Sadiya.

Lohit

- It originates in Tibet and then flows through Arunachal and Assam where it Joins Brahmaputra at Sadiya Town.

Burhi Dihing

- It originates in Arunachal Pradesh and meets Brahmaputra in Assam.

Dhansiri

- It originates in Nagaland and then meets Brahmaputra in Assam.

River Feni

- It originates in Tripura and flows towards Bangladesh.

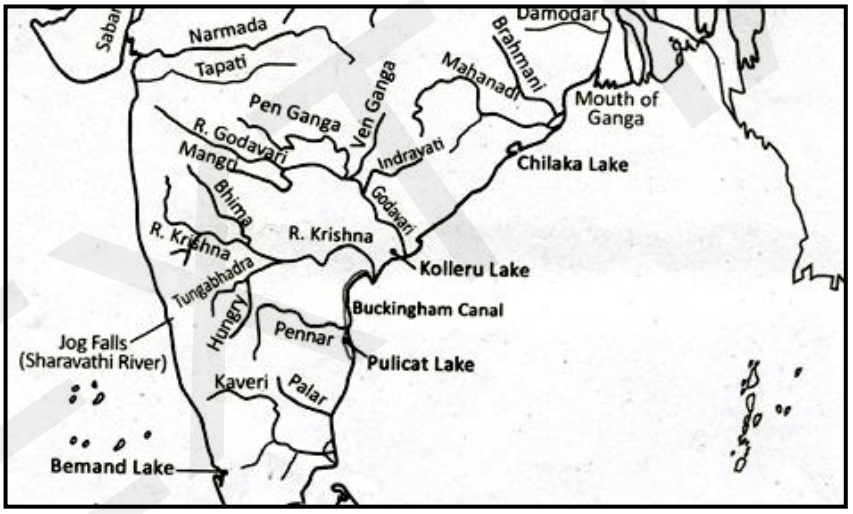
Some Facts

- Longest tributary of Brahmaputra is Teesta.
- Brahmaputra and its tributaries have maximum hydropower potential. Brahmaputra basin alone has 1/3 of total hydropower potential.
- Farakka is last town on river Ganga
- In Assam, Brahmaputra deposits sediments and creates braided channels resulting into formation of river islands.

- Assam has the maximum river island.
- Majuli is the world's largest river island in the world.
- Construction of Dams on this river by China Zangmu Dam, Jiacha dam, Jiexu dam, Yarlung Zangbo dam is under construction.
- It is a concern for India as China could control the flow of the Brahmaputra River. There is no treaty with China on water sharing of Brahmaputra. Upper riparian china therefore poses a threat to Arunachal Pradesh and northeast in War time.
- India wants China to run off river dams and share hydrological data.
- India decided to build a dam in Arunachal Pradesh upper Siang dam extra water will be stored which will compensate for sudden water flow from China.

Peninsular Rivers

- The Peninsular drainage system is older than the Himalayan drainage system. This is evident from the broad, largely-graded shallow valleys, and the maturity of the rivers.
- The Western Ghats running close to the western coast act as the water divide between the major Peninsular rivers.
- The rivers are broadly classified as East flowing rivers and West flowing rivers. The East flowing rivers drain into the Bay of Bengal and the west flowing rivers drain into the Arabian Sea.



RIVER SYSTEMS OF THE PENINSULAR DRAINAGE

East flowing rivers

Rivers originating in Chotanagpur Plateau

- River Mayurakshi
- River Ajay
- Damodar River known as Sorrow of Bengal.
    - Damodar Valley Corporation: It is the 1st multipurpose river valley project of India.

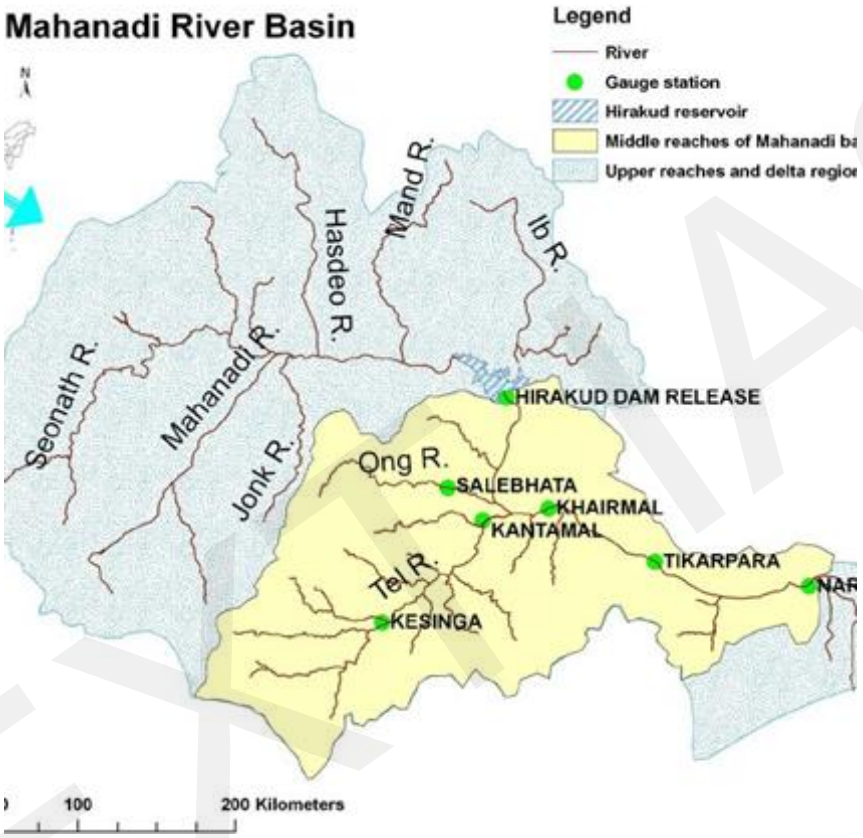
Suvarnrekha River

- It originates in Chotanagpur plateau, Jharkhand.
- It forms a natural boundary between Orissa and Bengal.
- Sediments of this river have gold particles that is why it is called Suvarnrekha,
- Jamshedpur (Jharkhand) is on the Bank of Suvarnarekha where Tata Steel Plant is located.

Baitarani River

- The Baitarani River originates from Guptaganga hills in Keonjhar District of Orissa
- The basin of the river lies mostly in Odisha and in Singhbhum District of Jharkhand.
- Originates in Chotanagpur (South Jharkhand – South Koel + Sanku)
- It is also called Gupt Ganga

Mahanadi River



- The Mahanadi rises near Sihawa in Raipur district of Chhattisgarh and runs through Odisha/
- 53 percent of the drainage basin of this river lies in Madhya Pradesh and Chhattisgarh, while 47 percent lies in Odisha.
- It is famous for Hirakud Dam. It is longest earthen material dam worldwide
- Its main tributaries are the Seonath, the Jonk, the Hasdeo, the Mand, the Ib, the Ong and the Tel.

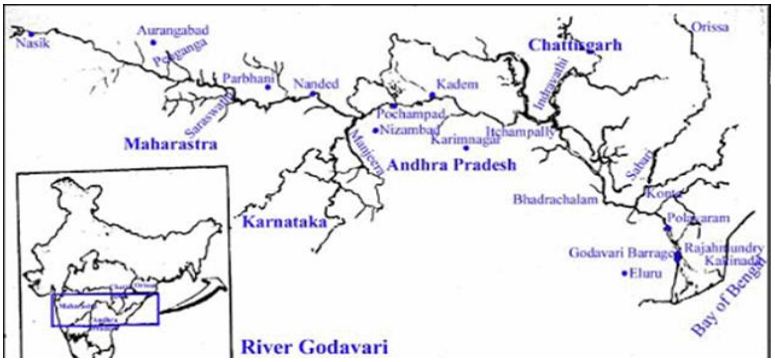
RushiKulya River

- It originates at an elevation of about 1000 metres from Daringbadi hills of the Eastern Ghats range.
- The place from where the river originates, Daringbadi is called the ' Kashmir of Odisha.
- Its tributaries are the Baghua, the Dhanei, the Badanadi etc and it has no delta as such at its mouth.
- It is famous for Olive Ridley turtle mass nesting.

Vamsadhara River

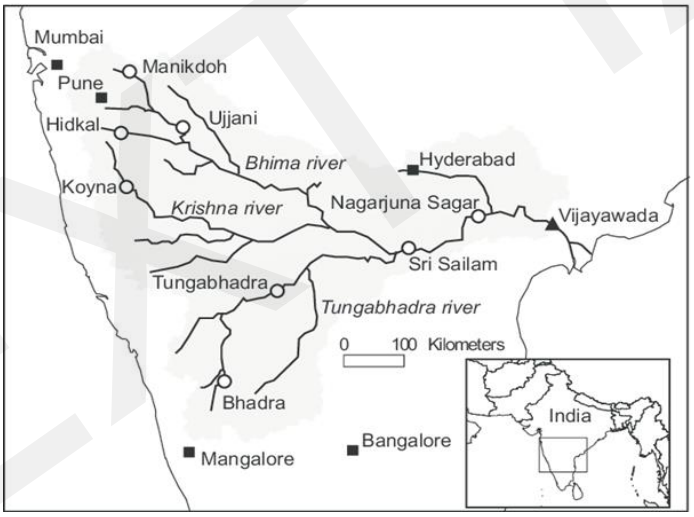
- The river flows between Mahanadi and Godavari
- Its basin lies in the state of Odisha and Andhra Pradesh.

Godavari River



- It is the 2nd longest river of India and longest in peninsular rivers.
- It has the 2nd largest river basin in India and is also known as Dakshin Ganga (south ganga).
- It originates from Nashik (Trimbakeshwar) and passes through states of Maharashtra, Chhattisgarh, Telangana and Andhra Pradesh.
- Major tributaries are: Penganga, Wainganga, Wardha, Pranhita, Manjra, Indravati.

Krishna River



- It is the 3rd longest river of India.
- It originates from Mahabaleshwar (Maharashtra) in western Ghats.
- It flows through the state of Maharashtra, Karnataka,Telangana, and Andhra Pradesh
- Its major tributaries are Koyna, Dhudganga, Panchganga, Ghatprabha ,Malprabha, Bhima.

SMALLER RIVERS SOUTH OF KRISHNA

Penneru or Pennar

- Origin-Karnataka, then flows through Andhra Pradesh

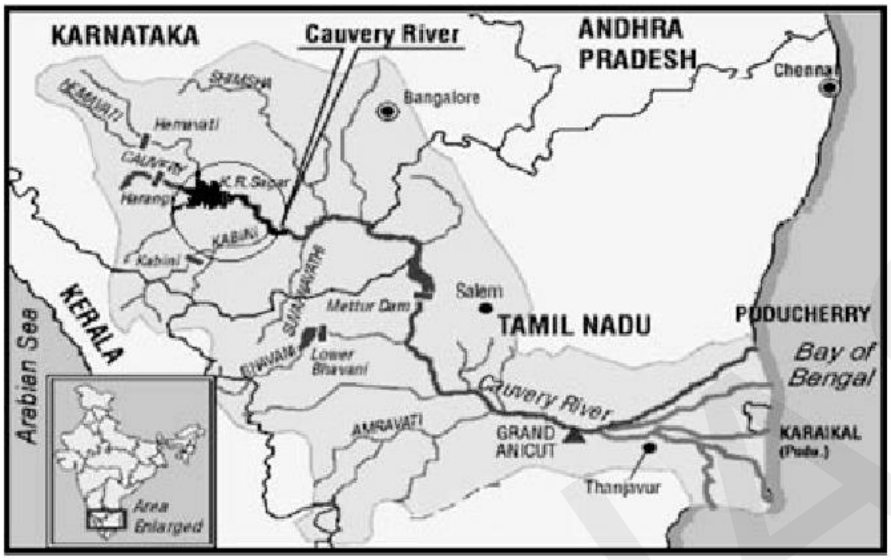
Palar

- Origin -Karnataka, then flows through Andhra and Tamil Nadu

Ponnaiyar

- Origin-Karnataka, then flows through Tamil Nadu

Kaveri River

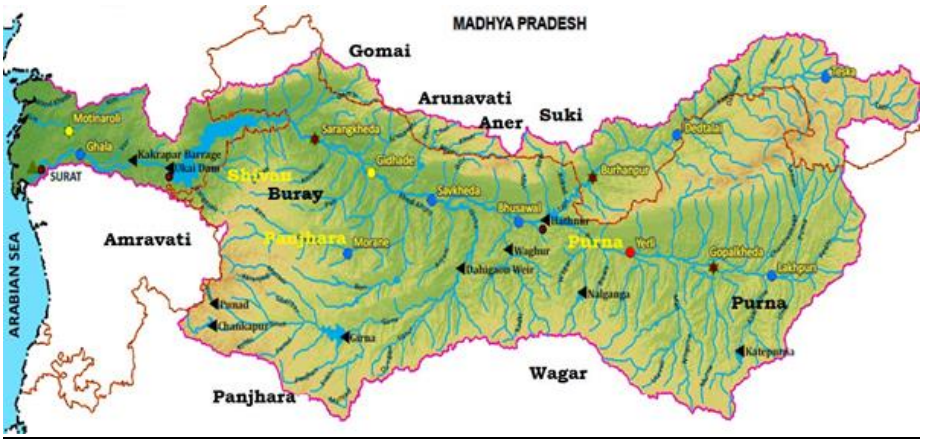


- It originates from Talakaveri point in Brahmagiri Range in Kodagu(coorg) district and flows through Karnataka and Tamil Nadu.
- Its major tributaries are Hemavati, Shimsha, Arkavati, Kabini, Amravati, Noyyal, Bhavani.
- The Kaveri water dispute between Tamil Nadu and Karnataka is the most disputed River in India.

West Flowing Rivers

- They are generally short and fast flowing rivers.
- It originates mainly from western ghats, hence these rivers have a steep flow.
- They are not able to deposit much sediment and therefore not form deltas.
- These rivers drain mainly in the Arabian sea.
- They have narrow mouths.
- They form estuaries, a mix of fresh water from rivers with saline water of the ocean. Estuaries are rich in biodiversity as a result western coast is good for fisheries.

Narmada River



- The Narmada originates on the western flank of the Amarkantak plateau.

- It flows through a rift valley between theSatpura in the south and the Vindhya range in the north
- Its basin covers large areas in the States of Madhya Pradesh, Gujarat and a comparatively smaller area in Maharashtra and Chhattisgarh.
- There is no delta formation by Narmada river.
- Narmada is the largest west flowing river of peninsular India.
- It rises from Maikala range near Amarkantak in Madhya Pradesh
- The river slopes down near Jabalpur where it cascades (a small waterfall, especially one in a series) 15 m into a gorge to form the DhuanDhar (Cloud of Mist) Falls. Since the gorge is composed of marble, it is popularly known as the Marble Rocks.
- Major tributaries are Hiran, Orsang, the Barna and the Kolar.

Tapi River

- It originates from Multai in the Betul district of Madhya Pradesh
- Nearly 79 percent of its basin lies in Maharashtra, 15 percent in Madhya Pradesh and the remaining 6 per cent in Gujarat and drains into the Arabian Sea through the Gulf of Cambay
- It is the second largest west flowing river of the Peninsular India.
- Major tributaries
- Right Bank: Suki, Gomai, Arunavati, Aner, Vaghur, Amravati, the Buray, the Panjhra, the Bori, Girona, Purna and Sipna

Sabarmati River

- Sabarmati is the name given to the combined streams the Sabar and Hathmati.
- It originates from Aravalli.
- The Sabarmati basin extends over states of Rajasthan and Gujarat
- The basin is bounded by Aravalli hills on the north and north-east, by Rann of Kutch on the west and by Gulf of Khambhat on the south.

Mahi River

- It originates from the northern slopes of Vindhyas at an altitude of 500 m in Dhar district of Madhya Pradesh.
- Its basin extends over states of Madhya Pradesh, Rajasthan and Gujarat drains into the Arabian Sea through the Gulf of Khambhat.
- It is bounded by Aravalli hills on the north and the north-west, by Malwa Plateau on the east, by the Vindhyas on the south and by the Gulf of Khambhat on the west.

Periyar River

- The Periyar River is the longest river in the state of Kerala also known as ‘Lifeline of Kerala’ as it is one of the few perennial rivers in the state.
- It originates from Sivagiri hills of Western Ghats and flows through the Periyar National Park.
- Major tributaries are Muthirapuzha, Mullayar, Cheruthoni, Perinjankutti.

INLAND RIVERS

- These are the rivers which do not reach an ocean or sea but empty their waters in a lake or an inland sea. Generally, they neither have a tributary nor a distributary.
- They are fed by rainy water and during rains they experience flash floods and get dried up in the dry season.

In India, large parts of the Rajasthan desert and parts of Aksai Chin in Ladakh have inland drainage.

Luni River

- Luni is the largest river system of Rajasthan, west of Aravali. It originates near Pushkar in two branches, i.e. the Saraswati and the Sabarmati, which join with each other at Govindgarh. From here, the river comes out of Aravali and is known as Luni.
- It flows towards the west till Telwara and then takes a southwest direction to join the Rann of Kuchchh. The entire river system is ephemeral
- Luni or the Salt River (Lonari or Lavanavari in Sanskrit) is named so because the water is brackish.

Ghaggar River

- It is located northward of the Luni river.
- It originates near the Himachal border and flows through the state of Haryana and Rajasthan.
- The Ghaggar is the most important river of inland drainage. It is a seasonal stream which rises on the lower slopes of the Himalayas and forms a boundary between Haryana and Punjab.
- It gets lost in the dry sands of Rajasthan near Hanumangarh

Interlinking of rivers

- The Idea of interlinking of Indian rivers was first proposed in 1858 by a British Irrigation Engineer, **Sir Arthur Thomas Cotton**. Later M. Visveswarayya, K. L. Rao and D. J. Dastur revived it in 1960s.
- The then Ministry of Irrigation formulated a **National Perspective Plan** (NPP) in **1980** envisaging inter basin water transfer in the country.
- NPP has two components- Peninsular Rivers Development, Himalayan Rivers Development
- **National Water Development Agency (NWDA**) was set up in **1982** by Government as a society under Societies Registration Act 1860.
- **14 links are under Himalayan River Development Component and 16 links are under Peninsular River Development Component**.
- Presently the nodal ministry concerning the projects is **Ministry of Jal Shakti**, Department of Water Resources, River Development and Ganga Rejuvenation.

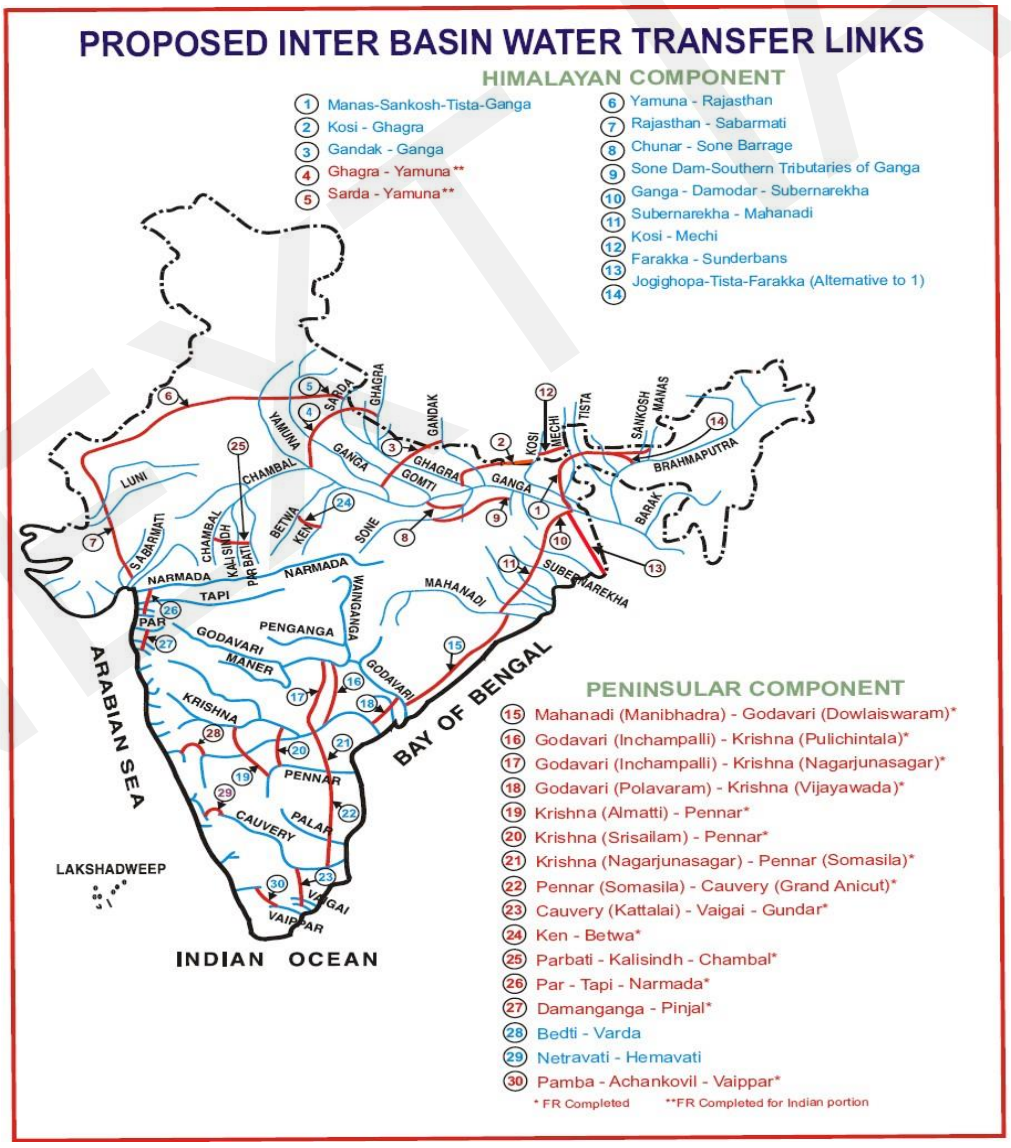


Fig 1: Proposed Inter-basin River links

The interlinking of rivers as the name suggest is making the link for water transfer between the water surplus basin where flooding occurs and water deficit basin where drought situation arises frequently. The government aims to fulfill this objective by building a network of reservoirs and canals through **National River Interlinking Project (NRLP),** which is also called the **National Perspective Plan**. By this the dual problem of flooding as well as drought in different parts of the country can be solved.

RIVER LINKING PROJECTS IN INDIA

Ken-Betwa Link Project (KBLP)

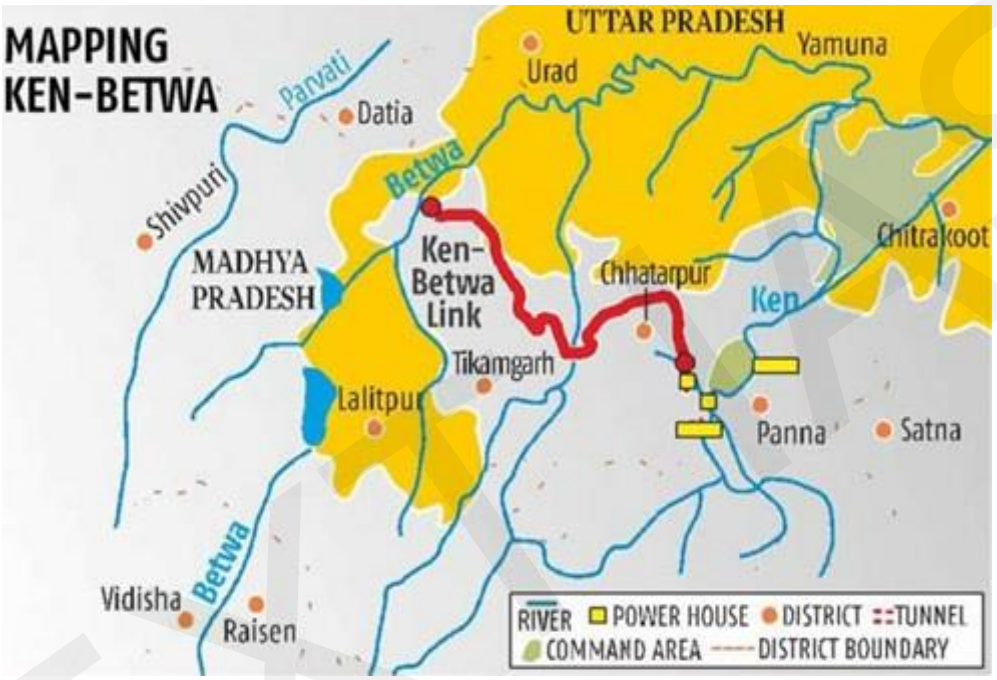


Fig 2: Ken-Betwa river link

- Both Ken and Betwa rivers are the **Right Bank Tributaries of River Yamuna**. These rivers flow in South Western Uttar Pradesh and Northern Madhya Pradesh. This link will benefit **Bundelkhand** Region.
- This project has been declared as **National Project in 2009** by the Government of India, which entailed 90:10 funding earlier i.e. 90% Union Government and 10% State Governments (U.P. & M.P.) and now it is 60:40. It is a part of Peninsular River Development Component of NPP.
- The transfer of water will be from **water surplus Ken River** to **water deficit Betwa River** under this project.
- The components of Ken-Betwa Link Project (KBLP) are **Lower Orr dam, Kotha Barrage and Bina Complex**.

Other Proposed River Linking Projects

Damanganga-Pinjal Link Project and Par-Tapi-Narmada Link Project

- Damanganga-Pinjal Link Project (DPLP) and Par-Tapi-Narmada Link Project (PTNLP), both come under Peninsular River Development Component of NPP.
- The areas of DPLP and PTNLP include the states of Maharashtra and Gujarat.

- Water from **water surplus Damanganga basin** is proposed to be diverted to **water deficit Mumbai City** through **Pinjal Reservoir** to meet the domestic water requirement.

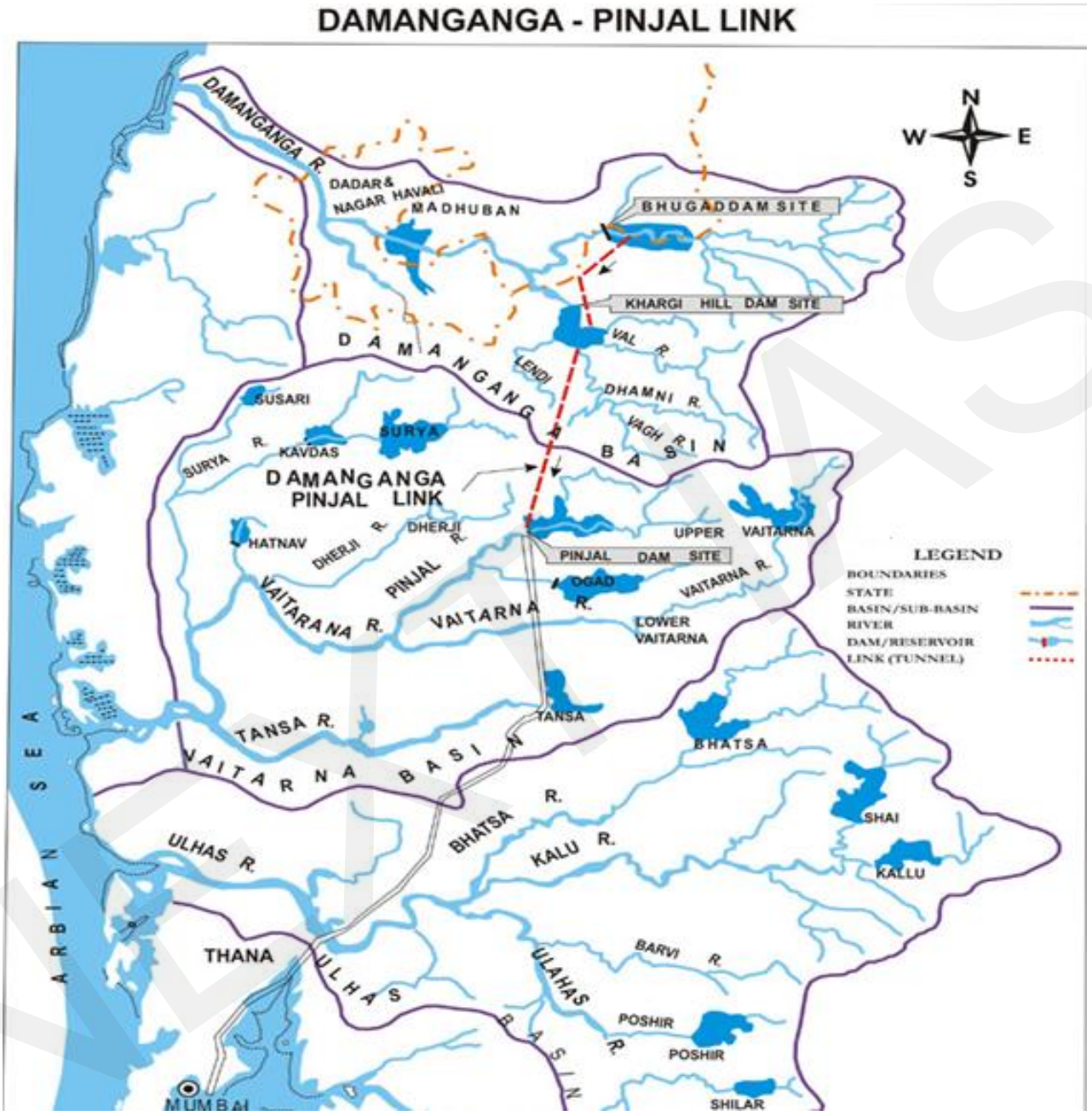


Fig 3: Damanganga-Pinjal Link

- **Pa-Tapi-Narmada Link Project (PTNLP)** proposes to transfer water from the water surplus regions of Western Ghats to the **water deficit regions of Saurashtra and Kutch**.
- Only one of the seven proposed reservoirs lies in the state of Maharashtra and others lie in Gujarat.

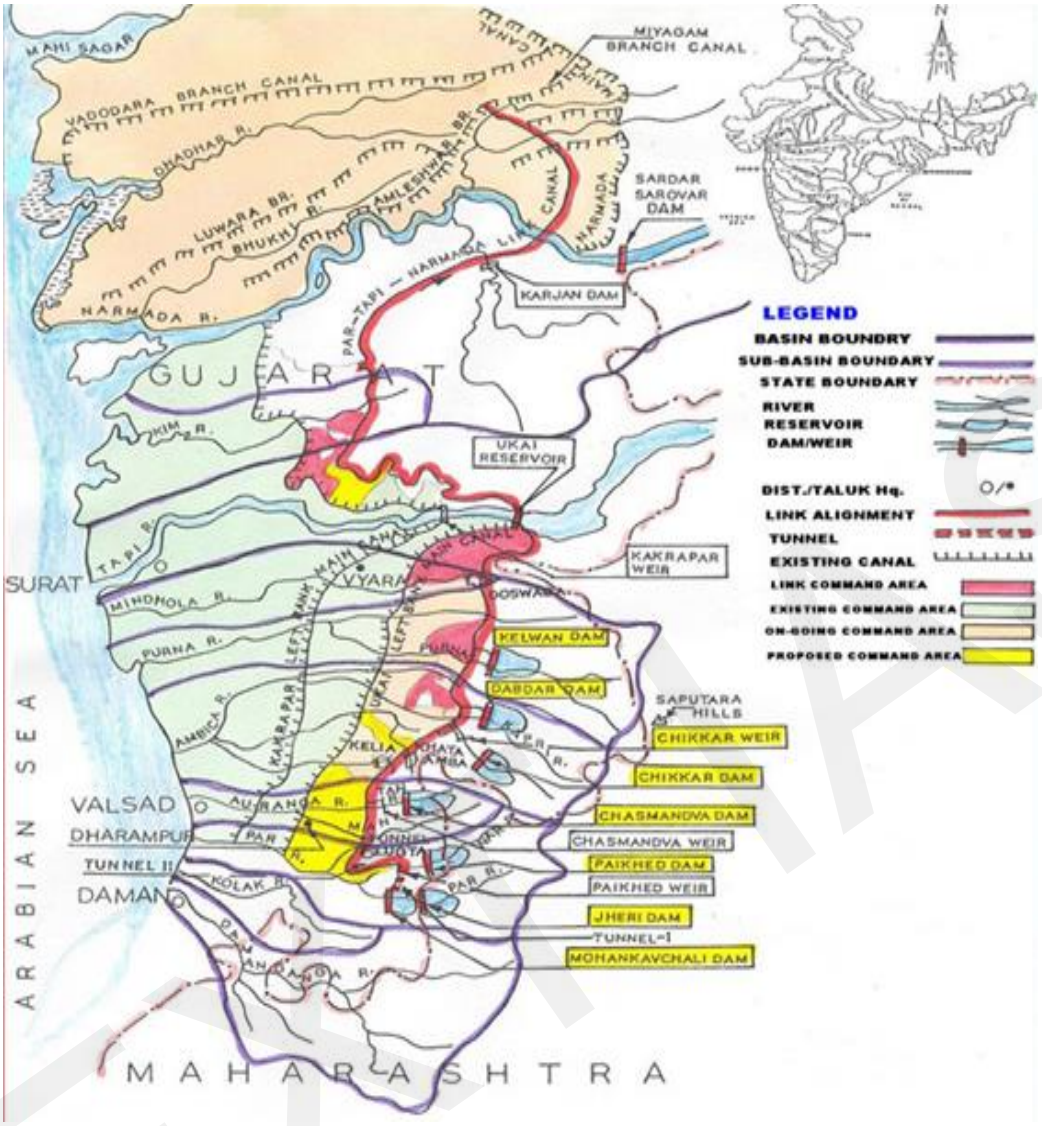


Fig 4: Par-Tapi-Narmada link

- Both river link projects have Project Report ready and their techno-economic appraisal is completed.

Mahanadi-Godavari Link Project

- Mahanadi-Godavari link is the first and the critical link of **Mahanadi-Godavari-Krishna-Pennar-Cauvery-Vaigai-Gundar Link** proposed under Peninsular River Development Component of NPP.

Fig 5: Mahanadi Cauvery river link

- This project envisages construction of a storage reservoir on Mahanadi River at Manibhadra and a link canal from this reservoir to the Godavari River.
- This project will benefit in irrigation, domestic, industrial water supplies and power generation as per the proposed scheme.
- Task force has approved the Detailed Project Report (DPR) of this project in February 2021.

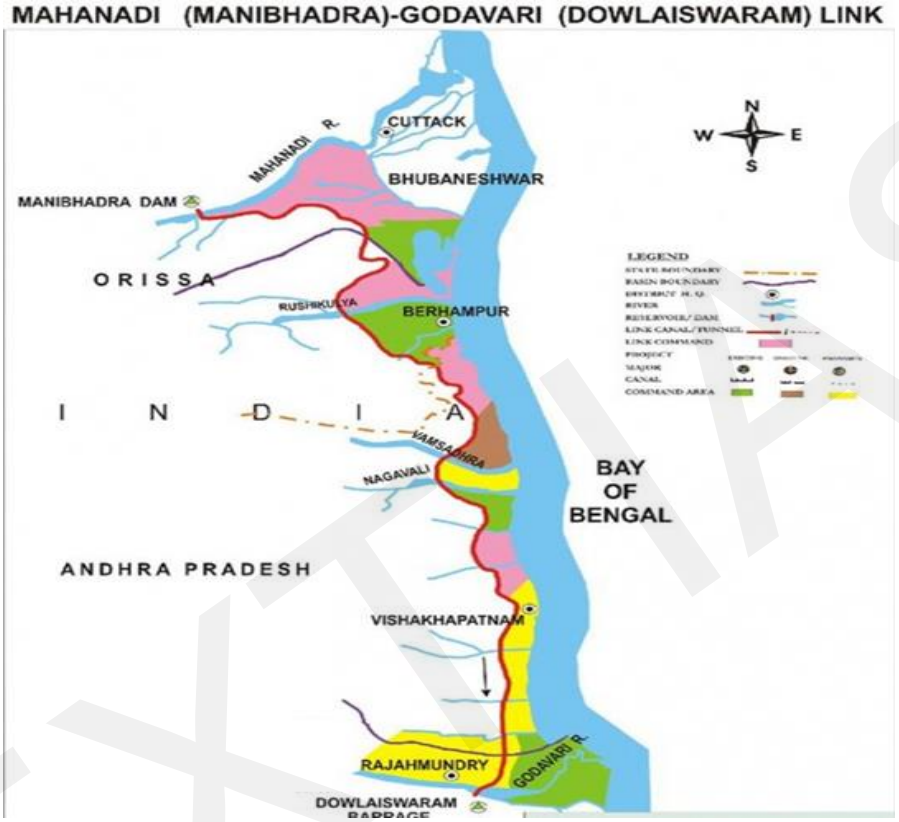


Fig 6: Mahanadi Godavari link

Godavari-Cauvery (Grand Anicut) link project

- The project proposes the diversion of unutilized water in the **Indravati sub-basin of Godavari basin** to meet the requirement of water deficit region between Godavari and Cauvery rivers.
- This link has 3 components-
    - Godavari (Inchampalli/Janampet) - Krishna (Nagarjunsagar)
    - Krishna (Nagarjunsagar) - Pennar (Somasila)
    - Pennar(Somasila) - Cauvery (Grand Anicut)

Manas-Sankosh-Teesta-Ganga (MSTG) Link Project

- MSTG link envisages diversion of surplus water of Manas, Sankosh and intermediate rivers for augmenting the flow of Ganga and provide water in Mahanadi basin.
- MST link passes through Manas Tiger Reserve which lies in Assam and Buxa Tiger Reserve which lies at the border of West Bengal.

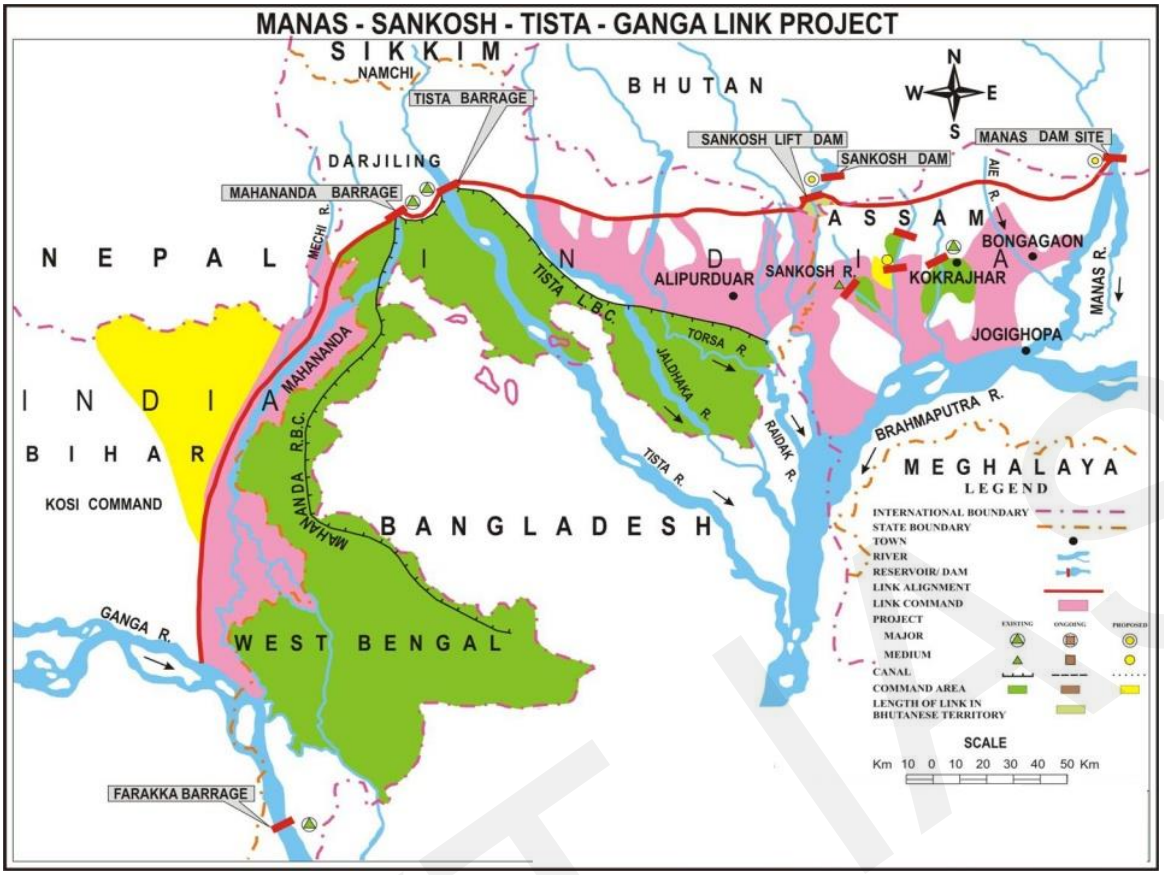


Fig 7: Manas-Sankosh-Tista-Ganga Link

Need of interlinking of rivers

- India faces the dual problem of flooding of some Himalayan rivers in Monsoon Season and drought in the peninsular India due to absence of perennial rivers. This issue can be addressed by interlinking of rivers.
- The problem of water shortage for domestic, farm, industrial sector etc. can be addressed by equitable distribution of water throughout the interlinked basins.

Merits of interlinking of rivers

- Flood Control in water surplus regions and Drought Control in water deficit regions.
- Inland water navigation (IWN) will be promoted and by this the issue of overburdened roadways/highways and pollution will be addressed and IWN is cheaper also.
- More irrigated area will drive more sown area in the country thereby increasing agricultural production, farmer's income and food security and this will help in accomplishing **Sustainable Development Goal (SDG) 2 of Zero Hunger**.
- This will promote Tourism and generate Employment in relevant sectors.
- This will also benefit Fisheries sector.
- Clean drinking water at homes, water availability for industries can also be increased.
- The projects have the Hydropower Potential of estimated **34000 MWs** thereby increasing Renewable Energy Production share of the country and **India's Nationally Determined Contribution (NDC**) will also be achieved. This is directly related to the **SDG 7** which is **Affordable and clean energy.**

Challenges/ Issues with interlinking of Rivers

At one hand the idea of interlinking if rivers has potential merits and on the other hand it has its own challenges associated with it. These are as follows-

- **Environmental challenges:**
  - Large scale deforestation is the basic need for the construction of dams and canals which directly affects the environment and country's forest coverage area.
  - Disturbance in the river ecology is another important issue as the Himalayan Rivers which are abundant in sediments will be interlinked with the Peninsular Rivers. This may affect the fish's species and other river creatures.
  - Constructed dams will submerge large area of land of forest reserves, wildlife sanctuaries etc which will lead to the migration of animals from their habitat.
  - Dams and Canals associate with them the Seepage problem which ultimately results in increasing soil salinity in nearby areas and reduction in agricultural production.
  - Climate change is leading changes in glaciers and rainfall pattern; this may convert surplus basins to deficit basins and vice versa.
- **Social and political challenges:**
  - **Land acquisition** from nearby villagers is a hurdle as they perceive it as their ancestral land and reside and perform agriculture there. In the tribal areas, it is the main social concern as tribal people collect minor forest produce (MFP) from the forests and it is their only livelihood.
  - **Displacement** of people and providing residential area with all the amenities will be difficult.
  - Water is a **state subject** in India. It may lead to interstate water disputes as surplus states are not easily ready to share water with other states thereby increasing the project completion time and cost.
  - Political parties are not always willing to take the tough decisions as it is harmful for them in elections.
  - It may also lead to international water disputes affecting our foreign/international relations.
- **Technological and Economic challenges:**
  - At some places due to the terrain/physical features, there is a need to lift canals to transfer water from low lying or surplus regions to high areas or deficit regions.
  - These projects are very costly and go in Billions of USD as well as time taking, so it is difficult for Government to fund these infrastructures for a long run.

Suggestions and Way forward

- Before going for on-site construction works for interlinking of rivers, proper Environment Impact Assessment (EIA) study should be done. All the stakeholders should be involved in the project so as to easily and consensually moving forward in the developmental works.
- Conservation of water should be the prime motto for the government as well as the people. Timely advertisements, school initiatives, radio broadcasts, awareness campaigns

etc. related to conservation of water/reducing water wastage should be promoted by the Ministry and institutions.

- Alternatives of water conservation like rain water harvesting, ponds, watershed management, check dams, micro irrigation like drip and sprinkler irrigation should also be promoted at ground level.
- Promotion of less water consuming crops in water deficit areas should be promoted.