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ECONOMIC GEOGRAPHY

for Civil Services Exam

CONTENTS

ECONOMIC GEOGRAPHY

CHAPTER
1

AN INTRODUCTION TO ECONOMIC GEOGRAPHY

- Economic geography has been defined by the geographers as the study of human's economic activities under varying sets of conditions which is associated with production, location, distribution, consumption, exchange of resources, and spatial organization of economic activities across the world. It represents a traditional subfield of the discipline of geography. However, many economists have also approached the field in ways more typical of the discipline of economics.
- Economic geography has taken a variety of approaches to many different subject matters, including the location of industries, economies of agglomeration (also known as "linkages"), transportation, international trade, development, real estate, gentrification, ethnic economies, gendered economies, core-periphery theory, the economics of urban form, the relationship between the environment and the economy (tying into a long history of geographers studying culture-environment interaction), and globalization.

■ Branches of Economic Geography

- Thematically, economic geography can be divided into these sub disciplines:
  - Geography of resources
  - Geography of agriculture: It is traditionally considered the branch of economic geography that investigates those parts of the Earth's surface that are transformed by humans through primary sector activities. It thus focuses on structures of agricultural landscapes and asks for the processes that lead to these spatial patterns.
  - Geography of industry
  - Geography of international trade
  - Geography of transport and communication
  - Geography of finance

■ New Economic Geography

- With the rise of the New Economy, economic inequalities are increasing spatially. The New Economy, generally characterized by globalization, increasing use of information and communications technology, the growth of knowledge goods, and feminization, has enabled economic geographers to study social and spatial divisions caused by the rising New Economy, including the emerging digital divide.
- The new economic geographies consist of primarily service-based sectors of the economy that use innovative technology, such as industries where people rely on computers and the internet. Within these is a switch from manufacturing-based economies to the digital economy. In these sectors, competition makes technological changes robust. These high technology sectors rely heavily on interpersonal relationships and trust, as developing things like software is very different from other kinds of industrial manufacturing—it requires intense levels of cooperation between many different people, as well as the use of tacit knowledge. As a result of cooperation becoming a necessity, there is a clustering in the high-tech new economy of many firms.

CHAPTER

2

WATER RESOURCES

■ Introduction

- Water is one of our most vital resources. It dissolves and transports nutrients from the soil into the bodies of plants and animals, dissolves and dilutes many of our wastes, serves as a raw material for photosynthesis (which provides food for all living organisms), and is a major factor in world climate and weather patterns. Thus, all life on earth depends on water.

■ World Water Resources

- Water resources are divisible into two distinct categories: the **surface-water resources** & **the ground-water resources**. Each of these categories is a part of the earth's water circulatory system, called the hydrologic cycle, & is ultimately derived from precipitation, which is rainfall plus snow.

Surface Water

- Surface water is water in a river, lake or fresh water wetland, naturally replenished by precipitation and naturally lost through discharge to the oceans, evaporation, evapotranspiration and sub-surface seepage.
- Natural surface water can be augmented by importing surface water from another watershed through a canal or pipeline. **Brazil is the country estimated to have the largest supply of fresh water in the world, followed by Russia and Canada.**

Surface Water Resources of the World

Water source	Water volume, in cubic miles	Water volume, in cubic kilometers	Percent of freshwater	Percent of total water
Oceans, Seas, & Bays	321,000,000	1,338,000,000	—	96.54
Ice caps, Glaciers, & Permanent Snow	5,773,000	24,064,000	68.7	1.74
Groundwater	5,614,000	23,400,000	1.69	
Fresh	2,526,000	10,530,000	30.1	0.76
Saline	3,088,000	12,870,000	—	0.93
Soil Moisture	3,959	16,500	0.05	0.001

Ground Ice & Permafrost	71,970	300,000	0.86	0.022
Lakes	42,320	176,400	—	0.013
Fresh	21,830	91,000	0.26	0.007
Saline	20,490	85,400	—	0.006
Atmosphere	3,095	12,900	0.04	0.001
Swamp Water	2,752	11,470	0.03	0.0008
Rivers	509	2,120	0.006	0.0002
Biological Water	269	1,120	0.003	0.0001

Major Rivers of the World			
River	**Origin**	**Location**	**Outflow**
Nile	Tributaries of Lake Victoria, Africa	Africa	Mediterranean Sea
Amazon	Glacier-fed lakes, Peru	South America	Atlantic Ocean
Mississippi-Missouri-Red Rock	Source of Red Rock, Montana	United States	Gulf of Mexico
Chang-Jiang (Yangtze)	Tibetan plateau, China	China	China Sea
Ob	Altai Mts., Russia	Russia	Gulf of Ob
Huang He (Yellow)	Huang He (Yellow)	China	Gulf of Chihli
Yenisei	Tannu-Ola Mts., Western Tuva, Russia	Russia	Arctic Ocean
Parana	Confluence of Paranaiba and Grande rivers	Brazil, Paraguay, and Argentina	Río de la Plata
Irtish	Altai Mts., Russia	Russia	Ob River
Zaire (Congo)	Confluence of Lualab and Luapula rivers, Congo	Western Africa	Atlantic Ocean
The Ganga	Gangotri Glacier	India, Bangladesh	Bay of Bengal
The Brahamputra	Mansarovar	China, India	Bay of Bengal

Major Fresh Water Lakes of the World	
Name of Lake	**Location**
Lake Baikal (largest by volume)	Russia
Tanganyika	Tanzania, Congo, Burundi, Zambia
Superior	Canada, United States
Malawi	Malawi, Mozambique, Tanzania
Vostok	Antarctica

Major Brackish Water Lakes Of The World	
Name of Lake	**Location**
Bras d' or lake	Cape Breton Island Canada
Caspian sea (World's Largest Lake (By Surface Area)	Russia, Azerbaijan, Iran, Turkmenistan, Kazakhstan
Lake Charles, Louisiana	United States
Chilika Lake (largest Brackish water lake of Asia)	Odisha
Pulicat Lake	Andhra Pradesh

Use of Water Resources Worldwide	
Agriculture	93.37
Municipal and Rural water supplies	3.73
Industries and power generation	1.26
Livestock	1.08
Others	0.56
Total	100.00

⊙ Under River Flow

- Throughout the course of a river, the total volume of water transported downstream will often be a combination of the visible free water flow together with a substantial contribution flowing through sub-surface rocks and gravels that underlie the river and its floodplain called the **hyporheic zone.**
- For many rivers in large valleys, this unseen component of flow may greatly exceed the visible flow. **The hyporheic zone** often forms a dynamic interface between surface water and true groundwater receiving water from the ground water when aquifers are fully charged and contributing water to groundwater when ground waters are depleted. This is especially significant in karst areas where pot-holes and underground rivers are common.
- **Example: Amazon- Hunza river system** is the largest subterranean water body in the world. It is larger than Amazon river system which runs parallel to it beneath the main river.

■ Ground Water

- Sub-surface water, or groundwater, is fresh water located in the pore space of soil and rocks. It is also water that is flowing within aquifers below the water table.
- Sometimes it is useful to make a distinction between sub-surface water that is closely associated with surface water and deep sub-surface water in an aquifer (sometimes called "**fossil water**"). Sub-surface water can be thought of in the same terms as surface water: inputs, outputs and storage.
- The critical difference is that due to its **slow rate of turnover**, sub-surface water storage is generally much larger compared to inputs than it is for surface water. This difference makes it easy for humans to use sub-surface water unsustainably for a long time without severe consequences.
- Nevertheless, over the long term the average rate of seepage above a sub-surface water source is the upper bound for average consumption of water from that source.
- The natural input to sub-surface water is seepage from surface water. The natural outputs from sub-surface water are springs and seepage to the oceans.

■ Frozen Water

- **Glacier runoff** is considered to be surface water. The Himalayas, which are often called **"The Roof of the World"**, contain some of the most extensive and rough high altitude areas on Earth as well as the **greatest area of glaciers** and **permafrost** outside of the poles.
- Ten of Asia's largest rivers flow from there, and more than a billion people's livelihoods depend on them. To complicate matters, temperatures are rising more rapidly here than the global average.
- In Nepal, the temperature has risen with 0.6 degree over the last decade, whereas the global warming has been around 0.7 over the last hundred years.
- **List of longest glaciers in world in non-polar regions**

Glaciers	Length	Location
Fedchenko Glacier	77 km	Tajikistan
Siachen Glacier	76 Km	Karakoram range on Line of Control between India and Pakistan
Biafo Glacier	67 km	Pakistan
Brüggen Glacier	66 km	Chile
Baltoro Glacier	63 km	Pakistan
South Inylchek Glacier	60.5 km	Kyrgyzstan and China
Batura Glacier	57 km	Pakistan

■ Extent of Water Resources

- The world supply of water in all forms (vapour, liquid, and ice) is fixed. However, this supply is enormous, as shown by spacecraft pictures of earth. The world's water is unevenly distributed, and about **99.997 percent** of it is not readily available for human use.
- Only about **0.003 percent** of the world's water supply is uncontaminated fresh (or sweet) water - which is found in rivers, lakes, swamps, and shallow underground wells.
- About **97.2 percent** of the world's water is in the **oceans and saline lakes**; this water is unfit for drinking and agriculture. Most of the remaining **2.15 percent is in frozen form** tied up in ice caps glaciers and **0.65 percent** is fresh which is not completely available for use.
- Some of it is in vapour form in atmosphere, some found. In the soil, or some of it lies too far under the surface of the earth as groundwater.
- This leaves only **0.32 percent** of the world's water easily accessible to us as fresh water in rivers, lakes and relatively shallow underground deposits.

■ Water demand and use

- Water use has been increasing worldwide by about 1% per year since the 1980s. This steady rise has principally been led by surging demand in developing countries and emerging economies (although per capita water use in the majority of these countries remains far below water use in developed countries — they are merely catching up). This growth is driven by a combination of population growth, socio-economic development and evolving consumption patterns.

- Agriculture (including irrigation, livestock and aquaculture) is by far the largest water consumer, accounting for 69% of annual water withdrawals globally.
- Industry (including power generation) accounts for 19% and households for 12%.
- Global water demand is expected to continue increasing at a similar rate until 2050, accounting for an increase of 20 to 30% above the current level of water use.
- Although specific projections can somewhat vary, current analysis suggests much of this growth will be attributed to increases in demand by the industrial and domestic sectors.
- Agriculture's share of total water use is therefore likely to fall in comparison with other sectors, but it will remain the largest user overall over the coming decades, in terms of both water withdrawal and water consumption.

Water availability

- Over 2 billion people live in countries experiencing high water stress. Although the global average water stress is only 11%, 31 countries experience water stress between 25% (which is defined as the minimum threshold of water stress) and 70%, and 22 countries are above 70% and are therefore under serious water stress (UN, 2018a). Growing water stress indicates substantial use of water resources, with greater impacts on resource sustainability, and a rising potential for conflicts among users.
- Estimates suggest that if the degradation of the natural environment and the unsustainable pressures on global water resources continue, 45% of the global gross domestic product (GDP), 52% of the world's population and 40% of global grain production will be at risk by 2050. Poor and marginalized populations will be disproportionately affected, further exacerbating already rising inequalities (UN, 2018a).

Utilisation and Related Problems

- Humans use water for three major purposes:
  - Irrigation to grow food,
  - Industrial uses, and
  - Domestic and commercial uses.

Uses of fresh water

- Uses of fresh water can be categorized as consumptive and non-consumptive (sometimes called "renewable").
- A use of water is consumptive if that water is not immediately available for another use. Losses to sub-surface seepage and evaporation are considered consumptive, as water herein is incorporated into a product (such as farm produce).
- Water that can be treated and returned as surface water, such as sewage, is generally considered non-consumptive if that water can be put to additional use.
- Water is used following are the main uses of water:

Agricultural Use

- It is estimated that 69% of worldwide wate is used for irrigation, with 15-35% of irrigation withdrawals being unsustainable. It takes around 3,000 liters of water, converted from liquid to vapour, to produce enough food to satisfy one person's daily dietary need.

Industrial Use

- It is estimated that 22% of worldwide water is used for industrial purposes for e.g., hydroelectric dams, thermoelectric power plants, cooling, ore and oil refineries, chemical processes, and manufacturing plants.

Household

- It is estimated that 8% of worldwide water use is for household purposes. These include drinking water, bathing, cooking, sanitation, and gardening.

Recreation Use

- Recreadtional water refers to rivers, lakes & coastal waters. People uses this water for various activities like swimming, boating, fishing etc.

Environmental Use

- Environmental water usage includes watering of natural or artificial wetlands artificial lakes intended to create wildlife habitat, fish ladders, and water releases from reservoirs timed to help fish spawn, or to restore more natural flow regimes.
- Environmental water entitlements provide a right to water that can be actively managed to benefit the environment.

Expansion of Business Activity

- Business activity ranging from industrialization to services such as tourism and entertainment continues to expand rapidly. This expansion requires increased water services including both supply and sanitation, which can lead to more pressure on water resources and natural ecosystems. **Rapid Urban Expansion,** the trend towards urbanization, is accelerating.
- Small private wells and septic tanks that work well in low-density communities are not feasible within high density urban areas. Urbanization requires significant investment in water infrastructure in order to deliver water to individuals and to process the concentrations of waste water both from individuals and from business. These polluted - and contaminated waters must be treated or otherwise they pose unacceptable Public health risks.

Water Stress

- According to the **World Business Council for Sustainable Development**, the concept of water stress applies to situations where there is not enough water for all uses, whether agricultural, industrial or domestic. Defining thresholds for stress in terms of available water per capita is a tedious job, however, it entails assumptions about water use and its efficiency.
- Nevertheless, it has been proposed that when annual per capita renewable freshwater availability is less than 1,700 cubic meters, countries begin to experience periodic or regular water stress. Below 1,000 cubic meters, water scarcity begins to hamper economic development, human health and well-being.

Problems related to fresh water

- Out of the total fresh water supply, only about 8 percent of the annual runoff is withdrawn, and according to estimates it is economically feasible for most areas to tap 20 percent of the annual runoff. The remaining 80 percent is in rivers and groundwater flows that are too far away from human's reach or is too expensive or contaminated to use.
- Although the average world water supply seems sufficient, many parts of the world face continuous or periodic water problems, which are expected to get worse in the future. This situation is caused by four major factors:

- Rising **demands for water** for all uses,
- The very **unequal distribution of the world's water**, and
- **Increasing pollution of water** supplies. In other words, much of the world's water is located in the wrong place, available at the wrong time, or of the wrong quality.
- **Increasing population** pressure.

■ India's Water Resources

- India has a total geographical area of 329 Mha having an annual precipitation of 4000 BCM with wide temporal and spatial variation. From river basin point of view India has been divided into 20 river basins.
- The water resources potential of the country, which occurs as a natural runoff in the rivers is about 1999.20 Billion Cubic Meters (BCM).
- It constitutes a little over 4% of the total river water of the world. However, due to various constraints of topography and uneven distribution over space and time, only about 1123 BCM of the total annual water potential can be used beneficially.
- This can be achieved by use of 690 BCM of utilizable surface water and 433 BCM through ground water.
- Water supply for drinking purpose has been accorded topmost priority in water allocation and its various uses, but major utilization is for irrigation purpose.
- As on 2018-19, Ultimate Irrigation Potential (UIP) estimated for the country is 139.89 Mha, out of which the assessed potential through major and medium irrigation projects is 58.47 Mha.

Surface Water Resources

Basin	Average annual - Run-off km^3	Utilisable Flow km^3	Storage completed km^3
1. Indus	73	46	14.52
2. Ganga	501	250	37.5
3. Brahmaputra	537	24	1.09
4. Barak Sub-basin	60	-	-
5. Mahanadi	67	50	8.93
6. Brahmani	36	18.1	4.29
7. Godavari	119	76	17.27
8. Krishna	68	58	32.23
9. Cauvery	21	19	7.25
10. Penner	6.81	6.81	2.37
11. Narmada	41	34.5	3.02
12. Tapi	18	14.5	8.68
13. Sabarmati	3.8	1.91	1.3
14. Mahi	41	34.5	30.02

Ground Water Resource

Basin-wise Ground Water Resource Potential

Sl. No.	Basin	Total replenishable Ground water resource (Million hectares metre per year)	Utilisable ground water for irrigation (Million hectares-metre per year)	Level of ground water development (per cent)
1.	Indus	2.55	2.17	79.29
2.	Ganga	17.17	14.59	30.79
3.	Kuchchh and Saurashtra composite	1.39	1.14	39.75
4.	Khambhat Composite	0.79	0.67	30.21
5.	Narmada	1.19	1.01	15.31
6.	Tapi	0.82	0.67	20.19
7.	Subarnrekha	0.22	0.19	8.81
8.	Brahman with Baitarni	0.59	0.50	5.16
9.	Mahanadi	2.13	1.81	4.32
10.	North-East composite	2.28	1.94	13.53
11.	Godavari	4.68	3.94	14.98
12.	Krishna	2.66	2.23	29.11
13.	Penner	0.50	0.43	31.52
14.	Madras composite and south Tamil Nadu composite	2.09	1.78	45.94
15.	Cauveri	1.36	1.16	44.72
16.	Western Ghat composite	1.83	1.54	19.61
17.	Brahmaputra	2.79	2.37	2.12
18.	Meghna	0.18	0.15	3.21
	Total	**45.22**	**38.28**	**27.82**

■ Inter-state River Water Disputes in India

- Most rivers of India are plagued with interstate disputes. Almost all the major rivers of the country are inter-state rivers and their waters are shared by two or more than two states.

- After independence, demand for water had been increasing at an accelerated rate due to rapid growth of population, agricultural development, urbanization, industrialization, etc. These developments have led to several inter-state disputes about sharing of water of these rivers.
- Following are the interstate river water disputes:
- **Cauvery water** dispute between Tamil Nadu, Karnataka and Kerala.
- The **Krishna water dispute** between Maharashtra, Karnataka and Andhra Pradesh.
- The **Tungabhadra water dispute** between Andhra Pradesh and Karnataka.
- The **Aliyar and Bhivani river water dispute** between Tamil Nadu and Kerala.
- The **Godavari river water dispute** between Andhra Pradesh, Madhya Pradesh, Chhattisgarh, Odisha and Karnataka.
- The **Narmada water dispute** between Gujarat, Maharashtra, Madhya Pradesh and Rajasthan.
- The **Mahi river dispute** between Gujarat, Rajasthan and Madhya Pradesh.
- The **Ravi and Beas river water dispute** between Punjab, Haryana, Himachal Pradesh, Rajasthan, Jammu and Kashmir and Delhi.
- The **Satluj-Yamuna Link canal dispute** between Punjab, Haryana and Rajasthan.
- The **Yamuna river water dispute** between Uttar Pradesh, Haryana, Himachal Pradesh, Punjab, Rajasthan, Madhya Pradesh and Delhi.
- The **Karamanasa river water dispute** between Uttar Pradesh and Bihar.
- The **Barak river water dispute** between Assam and Manipur.
- Efforts are being made to resolve disputes through negotiations amongst the basin states with the assistance of the Central Government. Many of these interstate river water disputes have been settled on the basis of **equitable apportionment** which is the universally accepted principle. Adjudication through appointment of water disputes tribunals is also resorted to as and when required.
- So far, the following tribunals have been appointed to resolve inter-state water disputes:
  - The Godavari Water Disputes Tribunal
  - The Krishna Water Disputes Tribunal
  - The Narmada Water Disputes Tribunal
  - The Ravi and Beas Water Disputes Tribunal
  - The Cauvery Water Disputes Tribunal
  - New Krishna Water Disputes Tribunal
  - Vamsadhara Water Disputes Tribunal
  - Mahadayi Water Disputes Tribunal
  - Mahanadi Water Disputes Tribunal

■ National Water Policy (2012)

- The National Water Policy 2012 was adopted to conserve, develop and better manage water resources in the country. Some of the important recommendations of this policy are :
  - Emphasis on the need for national framework law.
  - Comprehensive legislation for optimum development of inter-state rivers and river valleys.
  - Evolving a system of benchmarks for water uses for different purposes to ensure efficient use of water.

- Setting up of Water Regulatory Authority in each state.
- Incentivizing recycle and reuse of water.

- It aims to incentivize water saving in irrigation through methods like aligning cropping pattern with natural resources endowments, micro irrigation, automated irrigation operation, evaporation—transpiration reduction, etc., undertaking conservation of rivers, river corridors, water bodies and infrastructure in a scientifically planned manner through community participation; and arresting ground water levels in over-exploited areas.

Jal Shakti Abhiyan

- Due to increasing water scarcity in urban centres like Chennai, and drought in many parts of central India, the Centre government has initiated the Jal Shakti Abhiyan as a jan-andolan or people's movement on water conservation.
- According to Jal Shakti ministry, there is no additional funding or specific targets for Jal Shakti Abhiyan (JSA) to achieve. There was plenty of money already allocated for existing schemes under the Central and State budgets. They can be converted into a single scheme, with a focussed approach.
- The conservation efforts will be supplemented by initiatives like developing block and district water conservation plans and 'krishivigyankendramelas' to promote efficient water use for irrigation and better crop choices.

Jal Jeevan Mission

- Jal Jeevan Mission, a central government initiative under the Ministry of Jal Shakti, aims to ensure access of piped water for every household in India.
- The mission's goal is to provide to all households in rural India safe and adequate water through individual household tap connections by 2024.
- The programme will also implement source sustainability measures as mandatory elements, such as recharge and reuse through grey water management, water conservation, rain water harvesting.

Interstate River Water Disputes (Amendment) Bill 2019

- It will set up one interstate river water tribunal for the entire country with different benches for different rivers, depending on the disputes.
- These benches comprising retired justices, officials and experts would deliver time-bound verdicts—not more than two years and extendable to one more year.
- So, any river water dispute between the states would be solved within a maximum of three years and the tribunal verdicts are legally enforceable and binding on the parties.
- There will be no need for the Centre to separately notify the verdicts, as per the provisions of the Bill, paving way for their automatic implementation.

Composite Water Management Index

- NITI Aayog first launched and conceptualized the CWMI in 2018 as a tool to instil the sense of cooperative and competitive federalism among the states. It was a first ever attempt at creating a pan-India set of metrics that measured different dimensions of water management and use across the lifecycle of water.

Composite Water Management Index 2.0

- Gujarat hold on to its rank one in the reference year (2017-18), followed by Andhra Pradesh, Madhya Pradesh, Goa, Karnataka and Tamil Nadu. In North Eastern and Himalayan States, Himachal Pradesh has been adjudged number 1 in 2017-18 followed by Uttarakhand, Tripura and Assam.
- The Union Territories have first time submitted their data and Puducherry has been declared as the top ranker.
- In terms of incremental change in index (over 2016-17 level), Haryana holds number one position in general States and Uttarakhand ranks at first position amongst North Eastern and Himalayan States. On an average, 80% of the states assessed on the Index over the last three years have improved their water management scores, with an average improvement of +5.2 points.

The Dam Safety Bill, 2019

- Dams are artificial barriers on rivers which store water and help in irrigation, power generation, flood moderation, and water supply. In India, dams higher than 15 m or between 10 m and 15 m height that fulfil certain additional design conditions are called large dams. India has 5,745 large dams (includes dams under construction.
- Most of these large dams are in Maharashtra (2394), Madhya Pradesh (906), and Gujarat (632). As a large amount of water may be stored in a dam's reservoir, its failure can cause large scale damage to life and property. Therefore, monitoring dam safety is essential.
- It provides for proper monitoring, inspection, operation and maintenance of all specified dams in the country.
- It will create a national committee on dam safety which shall evolve dam safety policies and necessary regulations.
- It will also create a national dam safety authority as a regulator to implement policy, guidelines, and standards for dam safety.
- It will maintain and publish data of all dams and resolve inter-state disputes. It will also fix the accountability of dam maintenance with penal provisions.

Multipurpose River-Valley Projects in India

Almatti Dam

- It is a hydroelectric water project constructed on the river Krishna in North Karnataka.

Baspa Hydro-Electric Project

- It is the first **Independent Power Producer** (IPP) project after the Government of India liberalized the power policy by inviting private sector participation in setting up a hydropower project on "BOO" basis.
- It is located in Kinnaur district of Himachal Pradesh. It is the largest private hydroelectric project and has been built by Jaypee group. It is located on Baspa River, a tributary of the Satluj.

Beas Project/Pong Dam

- It is a joint venture of the state governments of Punjab, Haryana and Rajasthan. It consists of two units: (i) Beas-Sutlej Link and (ii) Beas Dam at Pong. The project links the Beas and the Sutlej rivers in Punjab through 38.4 km of hills and valleys.

- The waters of the Beas were poured into the Sutlej River on July 10, 1977 at the first-ever man-made confluence of the two major rivers at Slapper in Himachal in a mighty bid to augment the water resources of the Gobind Sagar Lake of the Bhakra-complex.
- This was completed in a period of only 12 years with the cost of Rs. 380 crore.

- **Bhadra Reservoir Project**
  - It was constructed across the river Bhadra which is in Karnataka.
  - This project was the irigation scheme. It was undertaken by National water Management Project, to increase the production of rice.

- **Bhakra-Nangal**
  - This project is in Himachal Pradesh which is a largest **multipurpose project** in India and the highest straight gravity dam in the world (225.5 m high) on the river Sutlej.

- **Chambal Valley Project**
  - It is a joint undertaking by the Rajasthan and Madhya Pradesh state governments. The Rana Pratap Dam at Bhata, 48 km from Kotah, was inaugurated on Feb 9, 1970. The project comprises construction of two other dams: **Gandhi Sagar Dam in Madhya Pradesh** and **Jawahar Sagar (Kota) Dam in Rajasthan.**

- **Chamera Hydro-Electric Project**
  - The 540 MW Chamera hydro-electric project on the Ravi River in Himachal Pradesh was implemented with Canadian credit offer of about Rs. 335 crore.

- **Chukha Project (Bhutan)**
  - The 336 MW project is the most prestigious and largest in Bhutan. It has been funded by Government of India. The dam has been constructed on **Wang Chu River**. The project costed Rs 244 crore.
  - The project was owned bolely by the royal govenemnt of Bhutan.

- **Damodar Valley Project (West Bengal and Bihar)**
  - Principal objective of this multipurpose scheme is to control the flowing of the Damodar River which is notorious for its vagaries and destructiveness. It is designed on the lines of the Tennessee Valley Authority (T.V.A.) in U.S.A.

- **Dul-Hasti Hydro-Electric Project**
  - The Rs. 1263 crore project is being built on river Chenab in Jammu and Kashmir. The foundation of the project was laid in September 1984. The project will consist of a power plant of 390 MW capacities. The power house will be located underground.

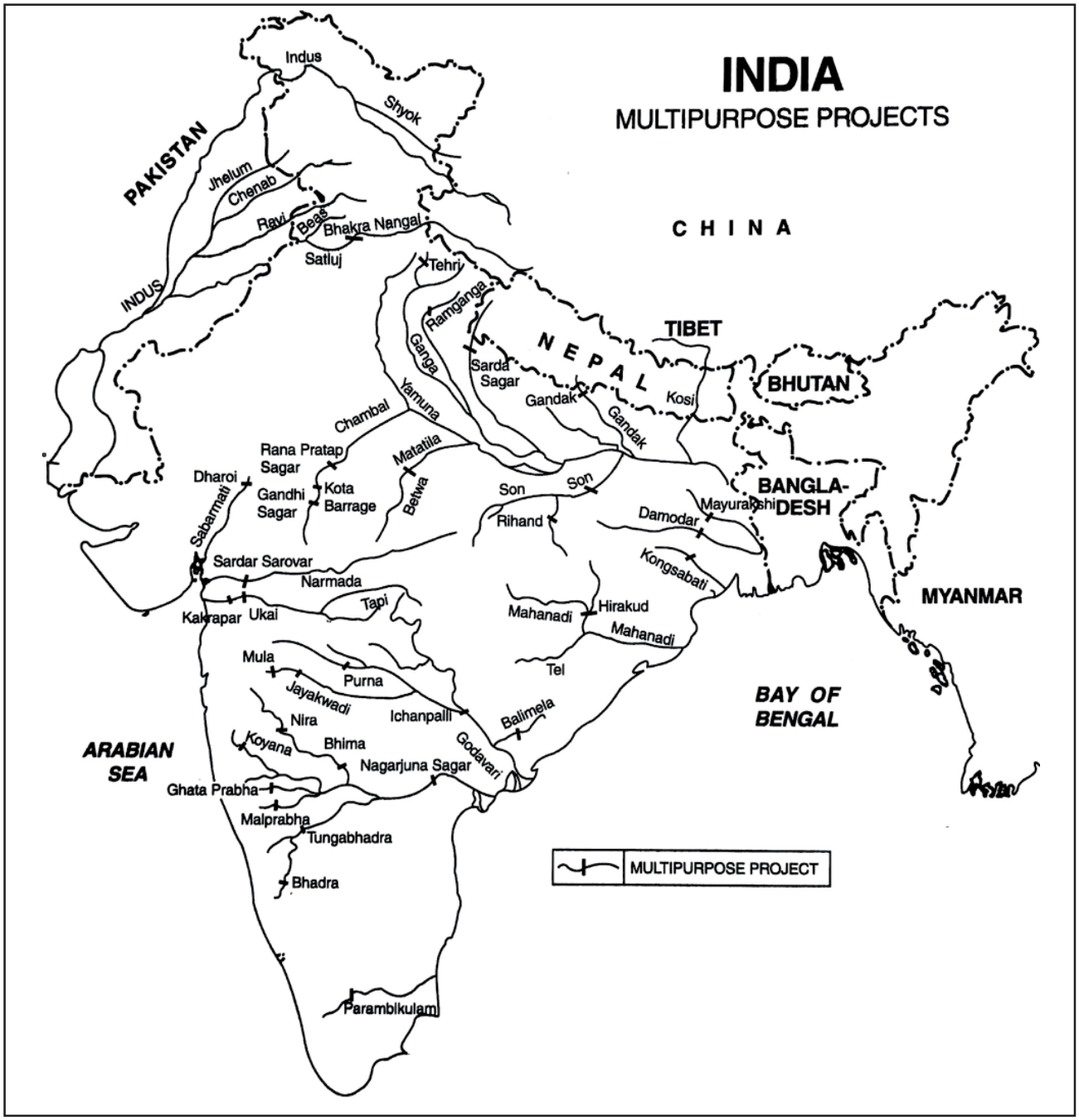
- **Dhauliganga Project**
  - The Rs. 600 crore, 280 MW project is to be located on Dhauliganga River in Uttarakhand close to the borders of Tibet & Nepal.

- **Farakka Barrage**
  - The basic aim of the Farakka Barrage is to preserve and maintain Calcutta port and to improve the navigability of the Hooghly river. It consists of a barrage across the Ganga at Farakka, another barrage at Jangipur across the Bhagirthi, a 39-km long feeder canal taking off from the right bank of the Ganga at Farakka and tailing into the Bhagirathi below the Jangipur barrage, and a road-cum-rail bridge have already been completed. Specially, the objective of Farakka is to use about 40,000 cusecs of water out of the water stored in the dam to flush the Calcutta port which is getting silted up.

- **Gandak Project (Bihar and U.P)**
  - This is a joint venture of India and Nepal as per agreement signed between the two governments on Dec 4, 1959 between Bihar and Uttar Pradesh. Nepal would also derive irrigation and power benefits from this project.
- **Hirakud Project (Odisha)**
  - It is the first of a chain of three Dams planned for harnessing the Mahanadi River.
- **Idukki Hydro-Electric Project**
  - It is a giant hydro-electric project of Kerala and one of the biggest in the country, constructed with Canadian assistance with an installed capacity of 390 MW in the first stage and 780 MW in the second stage.
  - The project envisages to harness the water of Periyar River, which has three major dams, the 169 m high Idukki arch dam across Periyar river, 138 m high Cheruthoni Dam across the tributary of Cheruthoni river and 99.9 m high Kulamavu Dam.
- **Jayakwadi Dam (Maharashtra)**
  - The 10-km-long Jayakwadi dam on the Godavari is Maharashtra's largest irrigation project located near Paithan.
- **Kalpong Hydro-Electric Project**
  - This is the first hydel power plant of Andaman and Nicobar Islands built across Kalpong River The 5.25 MW project was commissioned on July 1, 2001. It is located near Kalara village of Diglipur Tehsil in North Andaman and has been built by National Hydel Power Corporation.
- **Kakrapar Project**
  - It is situated on the Tapi River near Kakrapara, 80 km upstream of Surat. The project was financed by the Gujarat Government.
- **KoelKaro Project**
  - It was proposed in 1957 under the second five year plan.
  - The project envisages construction of earthen dam across river south Koel at Basia in Bihar and another dam over North Karo River at Lohajimi (Jharkhand). Its capacity will be 710 MW.
- **Kol Project**
  - The 600 MW project is to be located on the Satluj River 6 km upstream of the Dehar Power House on the Beas-Satluj link project in Mandi district, Himachal Pradesh. Besides generating power, the dam will also serve as a check dam for the 1,050-MW Bhakra Dam and prolong its life by at least 10 years.
- **Kosi Project**
  - This project is a joint agreement between Bihar and Nepal.
  - Kosi is called as Bihar's Sorrow because it caused frequent floods in Bihar. Indian governemnt proposed the construction of several dams and embankments on this river in Nepal.
- **Nagarjunasagar Project**
  - This Project utilizes the water of the Krishna River. This dam was inaugurated on Aug 4, 1967. It is situated near Nandikonda village in Miryalguda Taluk of Nalgonda district. It holds the record of being the tallest masonry dam.

- **Nathpa-Jhakri Hydro-Electric Project**
  - India's largest hydro-electric project, which is located at Nathpa Jhakri in Himachal Pradesh. It is the was built on Satluj River. The first of the six 250 MW units was commissioned on December 30, 2002. The project is being executed by **Satluj Jal Nigam** (formerly known as Nathpa Jhakri Power Corporation).
- **Parambikulam Aliyar Project**
  - It is a joint venture of Tamil Nadu and Kerala state governments. It envisages construction of seven inter-connected reservoirs by harnessing the water of two major rivers viz., Parambikulam on the western slopes and Aliyar on the eastern slopes of Annamalai Hills.
- **Parappalar Dam**
  - The Rs 1-crore Parappalar Dam with a storage capacity of 167 million cubic feet near Oddenchatram, about 75 km from Madurai in Palni taluk (Tamil Nadu), was inaugurated on August 30, 1976.
- **Parvati Valley Project**
  - It is the first inter-State hydel power project of India. Gujarat, Rajasthan, Haryana and Delhi have joined hands with Himachal Pradesh to set up this project. The 2050 MW project will be built near Kullu, on Parvati river, a tributary of Beas.
- **Periyar Valley Scheme (Kerala)**
  - The scheme envisages the construction of a masonry barrage 210.92 metres long across the river Periyar near Alwaye, in Ernakulam district.
- **Rajasthan Canal Project**
  - It is a bold venture of bringing irrigation to a desert area. The project, which uses water from the **Pong dam,** consists of 215-km long Rajasthan feeder canal (with the first 178 km in Punjab and Haryana and the remaining 37 km in Rajasthan) and the 467-km long Rajasthan main canal lying entirely in Rajasthan.
- **Ramganga River Project**
  - This Project in Uttarakhand envisages construction of a dam across the river Ramganga, one of the major tributaries of the Ganga at 3.2 km upstream of Kalagarh in Garhwal district.
- **Ranjit Sagar Dam Project**
  - Formerly known as Thein dam, was commissioned on March 4, 2001. It was built on the Ravi River near Thein village in Punjab. Its total installed capacity is 600 MW.
- **Rihand Project (Mirzapur District—U.P)**
  - This project has been completed by the U.P. Government and comprises the construction of a concrete gravity dam across the Rihand River in Mirzapur District (U.P.) and a Power House at Pipri and necessary transmission lines. Gobind Ballabh Pant Sagar is a part of this project.
- **Rongtong Project: World's Highest Hydro Power Project**
  - This project is situated in Kazan in the Spiti Valley in Himachal Pradesh. The project has helped in the transformation of the entire cold mountain desert into a lush greenbelt.
- **Salal Project**
  - It has been built on river Chenab in Jammu and Kashmir.
  - This is the largest Hydroelctric project commissioned in J & K so far. It is the country's first dam built on a rock pedestial & was commssioned by Rajiv Gandhi (former PM of India).

- **Sankosh Hydel-Power Project**
  - This is a joint venture of India and Bhutan building of a gigantic Sankosh hydel power project. It is one among the ten largest projects in Asia. The project is constructed near Kerabari in Gaylegphug district of Bhutan on Sankosh River.
  - It includes a 600 metre-long and 239 metre high dam and a reservoir with a catchment area of 10,525 sq km.

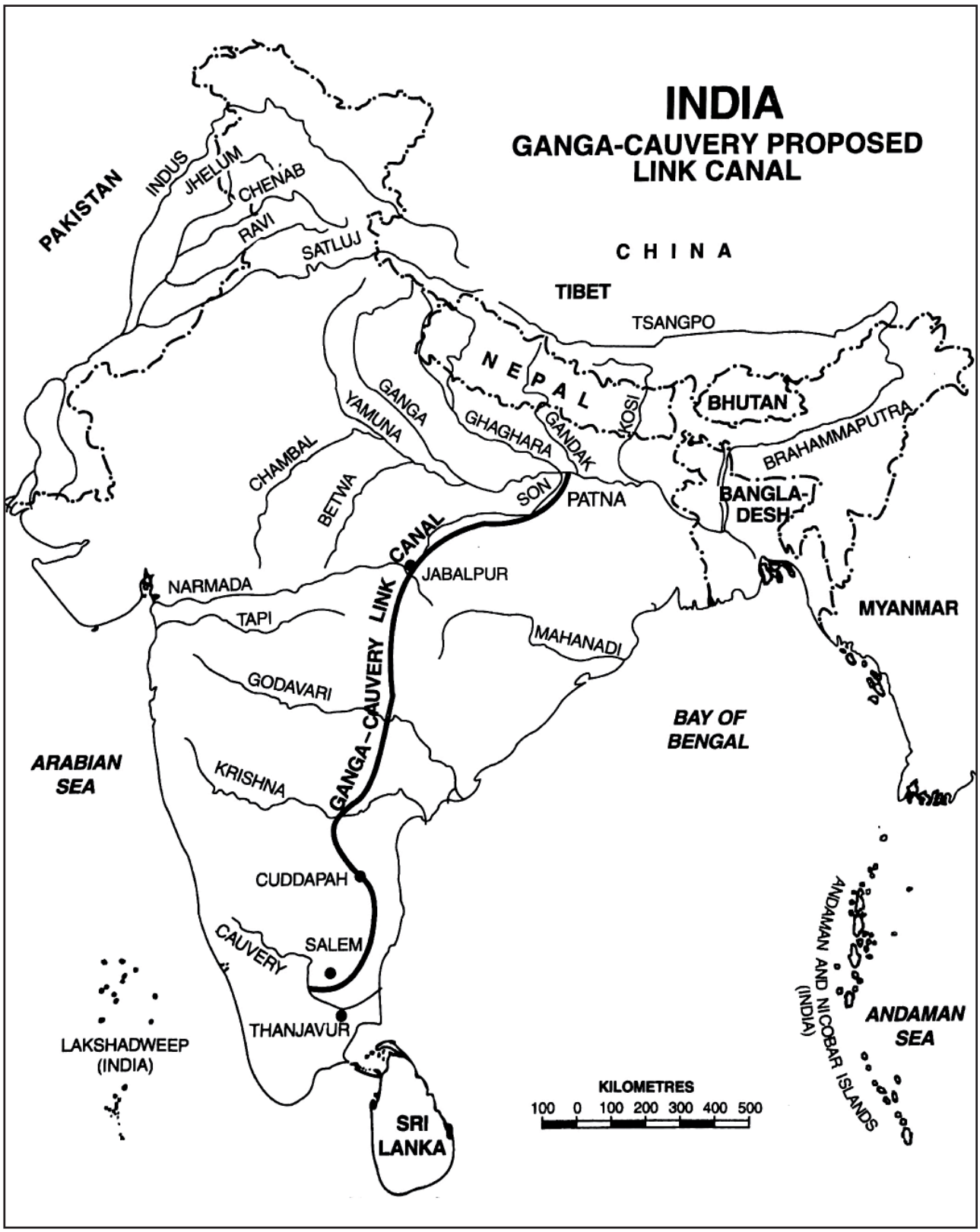


- **Sanjay Vidyut (Hydel) Project**
  - It is Asia's first fully underground Hydel Project. The 120 MW project is located near Bhaba Nagar in Kinnaur district of Himachal Pradesh. It harnesses the water of the BhabaKhud, a tributary of the Satluj River.

- **Sardar Sarovar Project**
  - It is one of the largest river valley schemes in the country. The project envisages the construction of 163-metre-high cement concrete dam at Navagam in Gujarat. This will create irrigation potential of 1.79 million hectares and generate 1450 MW of power.
- **Sawalkote Hydro Project**
  - The 600 MW project in Jammu & Kashmir is being built by a **Norwegian Consortium**.
- **Sharavati Project (Karnataka)**
  - It is located 400 km from Bangalore near the Gersoppa falls. This project is one of the world's major power projects, built by Indian engineers with American collaboration.
- **Srisailarn Project**
  - It is a massive power project, 110 km away from Nagarjunasagar, located in the upper reaches of the river Krishna.
- **Subarnarekha Project**
  - It is Rs 130-crore multipurpose project, which would, when completed, provide assured irrigation to 7,06,000 acres to the chronically drought-prone areas of Orissa and Bihar.
- **Tehri Dam Project**
  - The World's fifth and Asia's largest hydroelectric project has been constructed on river Bhagirithi, a tributary of Ganga in Tehri district of Uttaranchal. The height of the earth and rockfill dam is 260.5 m, making it the highest dam in the country. Once fully operational, the project will produce 1000 MW electricity.
- **Tungabhadra Project (Andhra And Karnataka)**
  - It is a joint undertaking by the governments of Andhra Pradesh and Karnataka. The project comprises a dam across the Tungabhadra River near Mallapuram.
- **Ukai Project**
  - It is a power project of Gujarat equipped with power generating sets manufactured by Bharat Heavy Electricals Limited was inaugurated on October 12, 1977. It has added a 540,000 KW of installed capacity to the State's existing power network.

■ Ganga-Cauvery River Link

- **United Nations** gives details of the proposed scheme of linking the Ganga with the Cauvery which is claimed to be one of the world's largest engineering projects.
- The U. N. teamprepared the project at the instance of the Government of India, have concluded that the ambitious project is technically feasible and vitally necessary for the development of the water resources in the country.
- The scheme first conceived by the **Central Water& Power Commission** is designed to link all the major rivers of India-the Ganges, Brahmaputra, Narmada, Tapi, Godavari, Krishna, Pennar and Cauvery-by means of a 3000 km long canal.
- It would revolutionize inland transportation by **creating a navigable system** equal to the combined length of the Rhine, Danube and Vistula waterways of Europe. The project is expected to cost $ 4,000 million and take 25 yearsto complete.
- The scheme is expected to **minimise the impact of droughts** by bringing under irrigation vast areas of agricultural land.
- One immediate benefit of the canal project would be the **alleviation of employment** among engineers and technicians.



Key Facts of the scheme

- Annually 25 billion cubic metres of water are to be lifted from the Ganges River near Patna up 460 metres to reservoirs on the Chotanagpur plateau.

- From these reservoirs the water, coursing across the Deccan plateau through a 3,300 km network of aqueducts, gravity canals, tunnels, natural water courses and reservoirs, will flow into the southern and western rivers.
- This network will consist of three main segments; linking the Ganges to the Narmada, the Narmada to the Godavari, and the Godavari to the river Cauvery.
- Through the Narmada River, water would be supplied to existing and planned irrigation systems in Gujarat and Rajasthan.

National Water Grid

- This is the largest ever thought of project of linking all major rivers of India with the help of a network of canals. It will help transfer water from water rich to water dificit regions. The idea of linking rivers across India to solve flood, drought, power and other water related problems of the country is not new. It has been mooted in different forms for the last few decades.
- A National Water Development Court of India ordered the central government to set up a National Water Development Agency (NWDA) July, 1982 to complete the project in 10 years.
- There were two components under it:
  - The Himalayan Rivers Development Component (for interlinking of Himalayan rivers)
  - The Peninsular Rivers Development Component (for interlinking of peninsular rivers)
- The process of development of water grid is still in process and aquifer mapping and components are put up in place.

Himalayan Rivers Development:

- This component envisages construction of storage reservoirs on the principal tributaries of Ganga and Brahmaputra rivers in India, Nepal and Bhutan along with interlinking of river systems to transfer surplus flows of the eastern tributaries of the river Ganga to the west, apart from linking of the main Brahmaputra and its tributaries with Ganga and Ganga with the river Mahanadi.

Peninsular Rivers Development:

- This component is divided into four major parts:
  - **Mahanadi-Godavari-Krishna-Cauvery Rivers:**
    - This part involves interlinking of the major river systems where surpluses from the Mahanadi and the Godavari are intended to be transferred to the needy areas in the south, through Krishna and Cauvery rivers.
  - **Interlinking of west flowing rivers, north of Bombay and south of Tapi:**
    - This scheme envisages construction of as much optimal storage as possible on these streams and interlinking them to make available appreciable quantum of water for transfer to areas where additional water is needed.
    - The scheme provides for taking water supply canal to the metropolitan areas of Mumbai; it also provides irrigation in the coastal areas in Maharashtra
  - **Interlinking of Ken-Chambal**
    - The scheme provides for a water grid for Madhya Pradesh, Rajasthan and Uttar Pradesh and interlinking canal backed by as much storage as possible.

- **Diversion of other west flowing rivers**
  - The high rainfall on the western side of the Western Ghats runs down into numerous streams which discharge into the Arabian Sea.
  - The construction of an interlinking canal system backed up by adequate storages could be planned to meet all requirements of Kerala as also for transfer of some waters towards east to meet the needs of drought affected areas.

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