

TERMS & CONDITIONS

1 Comptent Consultants of repute having experience in this field can participate in bidding. A demand draft of Rs 10,000.00 only (Rupees ten thousand only) in favour of **Engineer in Chief ,DW & S Department** payable at **Ranchi** should be attached with the technical proposal . Bidders have to submit self attested photo copy of Pan Card and sales tax clearance certificates along bid documents also. Bids must be delivered to the office of the under signed duly paged and signed on each page by the bidder on or before 3.00 PM on 22.10.2013 in tender box and will be opened on the same day at 3.30 PM, in presence of the bidders or his authorized representative. If the office happens to be closed on the date of receipt of the bids as specified, the bids will be received and opened on the next working day at the same time and venue.

Selection will be made based on particulars and documents furnished by the applicant as required and satisfactory verification carried out by the Department. Incomplete information in the application will lead to summary rejection. If any information furnished by the applicant is found incorrect at a later stage, they shall be liable to be debarred from tendering/taking up the workand their earnest money will be forfeited. Department reserves the right to verify the particulars furnished by the applicant independently.

2. The bidders should inspect the site personally before quoting the rates . Department reserves the right to accept or reject any or all applications without assigning any reasons whatsoever.
3. For any other clarifications, intending agencies may contact from the office of the undersigned or telephonically on telephone no 0651-2490920, 0651 2491422 before the last date of submission during working hours.
4. Incomplete applications and applications not filled properly with requisite details are liable for rejection and Department will not entertain any further communication in such cases.
5. ***The pre qualification meeting will be held in the office of the undersigned on 15.10.2013 at 12.30 PM. The pre bid meeting will be held in the office of the undersigned on 25.10.2013 at 12.30 Pm. for the clarification of queries.***
6. ***The nodal person for this will be Sri Sanjay Kumar Jha , TS to CE (HQ) , Mobile No. 9431120374 and Sri P.M .K. Rakesh , Executive Engineer (Investigation) Mobile No.9430771104 .***
7. ***The undersigned reserves the right to cancel any one or all offers without assigning any reason.***
8. ***Legal jurisdiction will be High Court Ranchi.***

Engineer in Chief

DW & S Department

Nepal House, Ranchi

GOVERNMENT OF JHARKHAND

DRINKING WATER AND SANITATION DEPARTMENT

NAME OF WORK:-

- (A) Detailed Survey , design and preparation of detailed project report for the construction of **Sone water grid for drinking water supply to the inhabitants of the rural villages of districts in route i.e. Palamau , Garhwa , Latehar , Chatra , Hazaribagh & Ramgarh** etc.
- (B) Detailed Survey , design and preparation of detailed project report for the construction of **Ganga water grid for drinking water supply to the inhabitants of the rural villages of districts in route i.e. Sahibganj , Dumka , Deoghar , Godda , Pakur , Giridih , Koderma & Jamtara** etc.

including contour studies of the entire area , geotechnical investigation , capacity determination of different components with the help of recent software's , Assessment of the related asset life , Due diligence of the population profile, Assessment of the quantum of work to be performed by way of construction and beautification work to be performed, SCADA automation for the web based total control , supervision and administrative control of all the activities and equipments including the grievance redressal , Cost of the project ,Project milestones to be achieved ,Environmental impact assessment ,Tender document preparation ,Technical Evaluation of the tender”.

The tentative names of the districts in route with their population for the year 2011 is being given for the preparation of the scheme.

SL. NO.	Name of the district	Population	Water requirement @200 LPCD in <u>ML</u> <u>Tentative</u>	Cumulative water Demand in MLD Tentative
1	2	3	4	5
1	Palamu	1939869	387.97	
2	Hazaribagh	1734495	346.90	734.87
3	Garhwa	1322784	264.56	999.43
4	Chatra	1042886	208.58	1208.01
5	Latehar	726978	145.40	1353.40
6	Ramgarh	949443	189.89	1543.29
TOTAL		7716455		1543.29

Base year = 2015 For 30 years

Design Demand Assuming 22.36 % decadal

3143 MLD

Water growth

AND

SL. NO.	Name of the district	Population	Water requirement @200 LPCD in <u>ML</u>	Cumulative water Demand in MLD
1	2	3	4	5
1	SAHEBGANJ	736835	147.37	
2	DUMKA	950853	190.17	337.54
3	GODDA	861182	172.24	509.77
4	DEOGHAR	933113	186.62	696.40
5	GIRIDIH	1496189	299.24	995.63
6	KODERMA	394763	78.95	1074.59
7	JAMTARA	544856	108.97	1183.56
8	Pakur	900422	367.21	1550.77
TOTAL		6818213		1550.77

Design water
Demand Assuming
22.36% decadal
growth

2836.79
MLD

The figures may vary after detail studies.

GOVERNMENT OF JHARKHAND
DRINKING WATER AND SANITATION DEPARTMENT

Nepal House, Dornada,
Ranchi-834002
Phone 0651 2490920

E-TENDER NOTICE

1. NAME OF WORK

PREPARATION OF DETAILED PROJECT REPORT FOR DRINKING WATER SUPPLY IN RURAL AREAS OF SELECTED DISTRICTS OF JHARKHAND THROUGH GANGA WATER GRID AND SON WATER GRID..

2. DISTRICTS INCLUDED (Tentative)

SL. NO.	Name of the district	Population	Water requirement @200 LPCD in <u>ML</u>	Cumulative water Demand in MLD
1	2	3	4	5
1	Palamu	1939869	387.97	
2	Hazaribagh	1734495	346.90	734.87
3	Garhwa	1322784	264.56	999.43
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TOTAL		7716455		1543.29

Base year = 2015 For 30 years

Design 22.36 % decadal
Water Demand Assuming growth

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TOTAL		6818213		1550.77

Design water
Demand Assuming
22.36% decadal
growth

2836.79
MLD

3. WORKS INCLUDED

Works include will consist of, but will not be limited to, carrying out, working out, identifying or detailing the following:

1. Topographical survey
2. Geohydrological/ geotechnical investigations
3. Assessment of existing drinking water conditions (including determination of capacity of various components of the existing system)
4. Assessment of water quality of various sources available within the area.
5. Assessment/ evaluation of related existing assets
6. Proposed most beneficial alignment of various pipeline.
7. Design of various components of the system proposed
8. Identification of requirement of energy, location wise
9. Estimation of the proposed works
10. Estimation of O & M cost
11. Willingness-to-pay survey, tariff proposed, anticipated revenues
12. Economics of the project
13. Sustainability of project, PPP
14. Financial structuring of the project
15. Environmental impact assessment
16. Requirement of land acquisition
17. Crossing of rivers, drains, bridges, culverts, railway lines, cutting of roads, pavements etc
18. Clearances/ permissions/NOC required before, during & after the implementation of projects.
19. Implementation schedule
20. Implementation and supervision of project
21. Management of completed project
22. Preparation of tender documents
23. Evaluation of the tenders

4. SPECIFICATIONS

The works included, as stated in Para-3 above will contain all necessary details required for the implementation of the project and will consist of, but will not be limited, to the following:

1. Contouring, studies for interval of one metre
2. Levelling with reference to a permanent bench mark
3. Network of permanent & temporary benchmarks to be established & be shown on the map, permitted closing error- 0.05m. Levels of all bench marks to be indicated on the map.
4. All important physical features such as roads, lanes, habitations, railway lines, power lines, telephone lines, natural drainage system, religious places (temples, mosques, churches, gurudwaras), schools, railway stations, bus stands, market places & commercial centres, ponds, lakes, other water bodies (natural as well as man-made), & offices etc to be shown on the map.
5. Existing water supply works to be shown.
6. Secondary sources of information, where available, such as hydrogeological geotechnical, or similar information, may be used.
7. Population projection to be made by various known methods using historical data & trend lines
8. Water requirement to account for wastage in treatment & distribution system
9. Conveyance mains to be designed on the basis of hydraulic rather than economic considerations
10. Distribution system to be designed with the use of softwares that integrate AutoCad to avoid possible discrepancy between drawings & the design data
11. Distribution system may be designed preferably for 24x7 supply
12. If intermittent distribution is proposed the distribution mains may be designed accordingly.
13. Dedicated power supply, or standby power supply may be provided at treatment sites. This (dedicated or standby) power may also be used for pumping clear water to storage reservoirs, if pumping is required. Option of solar / wind power etc. also be probed
14. Estimates to be based on state analysis of rates or CPWD rates where & to the extent applicable
15. Basic rates of material to be as per approved rates of the department for bulk quantities
16. Basic rates of labour to be in accordance with prevailing market rates but greater than minimum wages.
17. The entire area may be divided into zones for better hydraulic control and distribution management.
18. Each zone may, if necessary, be further sub-divided into sub-zones and each zone or sub-zone may be provided with bulk water meters along with a SCADA device.
19. All connections may be metered and provision for some meters, as may be expected at the initial stage, may be made in the estimate.
20. Economics of providing remote-reading meters may be furnished.
21. 'Management of completed project' may include provision of SCADA

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3. The bidders should inspect the site thoroughly before quoting the rates. Department reserves the right to accept or reject any or all applications without assigning any reasons whatsoever.

4. For any other clarifications, intending agencies may contact from the office of the undersigned or telephonically on telephone no 0651-2490920, 0651 2491422 before the last date of submission during working hours.

Incomplete applications and applications not filled properly with requisite details are liable for rejection and Department will not entertain any further communication in such cases.

5. The pre qualification meeting will be held in the office of the undersigned on 27.09.2013 at 12.30 PM. The pre bid meeting will be held in the office of the undersigned on 09.10.2013 at 12.30 Pm. for the clarification of queries

6. SEQUENCE OF EVENTS

1. GIS MAPPING OF THE ENTIRE AREA under consideration which will be fed from River Ganga Water Grid INCLUDING CONTOURING of the entire area.

2. To prepare gridline of pipelines to be laid with detail design and drawing for the supply of water to the Districts for feeding drinking water to the rural population.

2. Use of mobile technology along with GIS in planning, monitoring and evaluation, transparency is also widespread.

GIS based asset and complaint management system

3. Combining the technologies of GIS and SMS to make the monitoring easy, quick, cost effective and transparent.

4. The locations of the Rural Water Supply Schemes are marked using GPS.

5. A web interface shows the indicators data using different tables and graphs.

- Receive data on performance and functional indicators using entirely automated communication mediums.
- Sitting anywhere in the world, staff for DWSD can stay up to date on the functioning and performance
- Data transfer in real time.
 - Reduces data collection costs.
 - Low cost solution.
- Complaint Management System
 - Electronic entry of complaints.
 - Complaint status shown on map in different color.
 - Complainant feedback through SMS.

6. GIS based asset and complaint management system

- The department must have all the information as where they have laid the scheme's underground infrastructure.
- Access to information on any of scheme's asset by a click of a button.
- Aid in future planning of scheme's water infrastructure.
- Effective and full proof way of complaints management.
- Monitor staff's performance
- Direct consumers feedback on complaints
- Identify faulty areas
 - Survey of the reservoir including contouring of entire area including geotechnical investigation and water distribution grid chain determination with the help of recent software's
 - Assessment of the related asset life
 - Due diligence of the population profile
 - Assessment of the quantum of work to be performed by way of construction and beautification work to be performed
 - Study of the prevention of pollution from incoming water sources by intercepting, diverting and treating the pollution loads before entering the reservoir.

- Catchment area treatment may include afforestation, storm water drainage, silt traps.
- SCADA control of all the electromechanical equipments through wireless and GIS mapping .
- Cost of the project
- Project milestones to be achieved
- Environmental impact assessment
- Tender document preparation
- Technical Evaluation of the tender
- Assisting the department in the negotiation

1	The consultants are invited to submit a Technical Proposal and a Financial Proposal, for consulting services required for the Assignment. The proposal will be the basis for awarding the contract to the selected firm.
2	The Consultants must familiarize themselves with local conditions and take them into account while preparing their proposals. To obtain first- hand information on the Assignment and on the local conditions, consultants are encouraged to pay a visits to the Client before submitting a Proposal.
3	A demand draft of Rupees ten thousand in favour of : Engineer in Chief , Drinking water and Sanitation Department payable at Ranchi should be attached with the technical proposal.
4	The Client will provide the inputs related to the project needed to carry out the services, and make available relevant project data and reports on best effort basis.
5	Please note that (i) the costs of preparing the proposal and of negotiating the contract, including a visit to the Client, are not reimbursable as a direct cost of the Assignment; and (ii) the Client is not bound to accept any of the Proposals submitted.
6	DWSD requires that consultants provide professional, objective, and impartial advice and at all times hold the Client's interests paramount, without any consideration for future work, and strictly avoid conflicts with other assignments or their own corporate interests. Consultants shall not be hired for any assignment that would be in conflict with their prior or current obligations to other clients, or that may place them in position of not being able to carry out the assignment in the best interest of the Client.
7.	Consultants may be hired for Project Management Work, if the client feels it is essential.
8	Any previous or ongoing participation in relation to the assignment by the firm, Consultants should clarify their situation in that respect with the Client before preparing the proposal. (a) defines, for the purposes of this provision, the terms set forth below as follows : <ul style="list-style-type: none"> • " corrupt practice" means the offering, giving, receiving, or soliciting of anything of value to influence the action of a public official in the selection process or in contract execution; and • "fraudulent practice" means a misrepresentation of facts b in order to influence a selection process or the execution of a contract to the detriment of the Borrower, and includes collusive practices among consultants (prior to or after submission or proposals) designed to establish prices at artificial, non- competitive levels and to deprive the Borrower of the benefits of free and open competition. Client will reject a proposal for award if it determines that the firm recommended for award has engaged in corrupt or fraudulent activities in competing for the contract in question.
9.	The client may issue its own clarification on suo-moto basis or interested consultants may request a clarification of any of the RFP documents upto 14(fourteen) calendar days before the Proposal submission date. Any request for clarification must be sent in writing by paper mail, facsimile, or electronic mail to the Client's address as indicated in the clause :3 The Client will respond either by facsimile, or electronic mail to such requests and will send copies of the response (including an explanation of the query, but without identifying the source of inquiry) to the website : www: > daa.jharkhand.gov.in . So, it is important for the consultant to visit the website on regular basis before the proposal/bid due date.
10.	The evaluation committee selected by the DWSD as a whole and each of its members individually will evaluate the proposals and will give marks as per the Table A individually. The average of the marks will be the final technical score of the consultant. To technically quality the consultant must score at least 70% marks. The consulting firm not scoring 70% marks will be disqualified and the financial proposal of that bidder will not be opened.
11.	The Financial Proposal should follow Standard Forms as annexed in the document. The Financial

	Proposal should clearly identify the services tax payable by the client.			
12	Each Technical Proposal and Financial Proposal should be marked "Original" or "Copy". The consultant is required to submit one original and a duplicate copy. The original and one duplicate copy of the Technical Proposal shall be placed in a sealed envelope clearly marked " Technical Proposal", and the original and duplicate copy of the Financial Proposal in a sealed envelope clearly marked " Financial Proposal" and warning: " Do Not Open with the Technical Proposal". Both envelopes shall be placed into an outer envelope and sealed. This outer envelope shall bear the submission address and clearly marked, : DO NOT OPEN, EXCEPT IN PRESENCE OF THE EVALUATION COMMITTEE.'			
<u>Qualifying criteria, Submission format & Marking of Technical Bid :</u>				
Following table depicts the Qualifying criteria (as set out in the section A of the table) which the bidder must meet and the evaluation & submission structure (as set out in the section B of the table.) of the technical bid.				
Item	Criteria			
A. QUALIFYING CRETERIA				
A.	Financial Capability of the Firm (Minimum turnover of hundred crores)			
B.	One relevant experience in carrying out the technical consulting work for the preparation of water supply schemes in past five years having capacity of at least 25 % of the gross storage .			
C.	Expert required for this project :			
	S.No.	Position	Years of Experience	Specific Experts.
	1.	Team Leader	15	Degree in civil engineering having experience of 15 years in surveying , Design of the pipeline and allied structures for a major water supply scheme costing not less than 150 Crores.
	2.	Project Costing Expert.	10	Degree in engineering having experience of 10 years in civil works costing.
	3	Environmental Expert.	5.	Masters in Environmental Studies having experience of 5

				years in environmental impact assessment.	
	4.	Civil Engineers	10	Degree in civil engineering/ Architecture having 10 years of experience in surveying , Design of the pipeline and allied structures for a major water supply scheme costing not less than 150 Crores.	
	5	Software experts	10	Degree in Computer Science engineering/ Information Technology having 10 years of experience in GIS and other related programming and implementation.	
NOTE	[failing to meet any of the above requirement will result into rejection of the bid out rightly]				
B. Evaluation Methodology & Submission Format					
Item	Criteria				Maximum points
1.	Firms Overview [Kindly submit the 1. audited financial result duly signed by the Audit 2.the certificate of incorporation of the firm, 3. Income tax certificate 4. power of attorney of the authorized signatory]				No marks but the submission is required.
2	Concepts, methodology and work plan for				
2.1	GIS survey Methodology				
2.2	Asset life assessment Methodology				
2.3	Due diligence on the Population Profile (Cause & effect analysis)				

	2.4	Assessment of the quantum of work to be performed		
	2.5	Study of the prevention of pollution in the system		
	2.6	Catchment area treatment		
	2.7	<ul style="list-style-type: none"> SCADA control of all the electromechanical equipments through wireless and GIS mapping 		
	2.9	Prevention of pollution by non-point sources		
	2.10	Project Costing Methodology		
	2.11	Demand and Network analysis		
	2.12	Project Milestones design.		
	2.13	Maintenance methodology for the system		
	2.14	Environmental impact assessment		
	2.15	Tender document preparation		
	2.16	Technical evaluation of the tender		
	3.	<p style="text-align: center;"><u>Criteria for evaluation of Technical Bid</u></p> <p>Has been annexed as Annexure 1</p>		
	<p>Note : The bidders are strongly recommended that the technical bid must be submitted according to serial number as indicated in the table above (section B).</p>			
13.	The date of the opening of the financial proposal will be decided by the department and before opening of the financial proposal the consultant will be requested to do presentation on the date intimated by the department.			
14.	The Financial Proposals will be opened publicly in the presence of the consultants' representatives who choose to attend. The name of the consultant, the quality scores, and the proposed price will be read aloud and recorded when the Financial Proposals are opened. The Client will prepare minutes of the public opening and the representative of the consultant will put down the signature on the proceeding,. If requested a copy of the same proceeding will be provided to the representative of the consultant.			
15.	The completed Technical and Financial Proposal must be delivered at the submission address daa.jharkhand.gov.in . on or before the time said above in the NIT. The queries are to be addressed to : Engineer in Chief DRINKING WATER AND SANITATION DEPARTMENT NEPAL HOUSE , RANCHI Phone 0651 2490920			
16.	The financial proposals of all the qualified bidders will be opened and the work will be awarded to the lowest bidder.			
17	Deliverables & Payment Structure will be follows :			
S. No.	Deliverables.			Percentage of payment.

1.	Inception report: The report should cover the base line studies about the reservoir and the related assets. The consultant will collect the necessary information and will prepare the base line study report. The client will provide the necessary data, if available with the client. To be submitted within <u>2 months</u> after the work order.	5%
2.	Interim report: The report should cover the survey data, population benefitted with the projections and the impact of population on the reservoir, contour map of the entire area, GIS mapping of the entire area with route of the proposed pipe line and the requirement and availability of government land for the commissioning of water supply infrastructures. To be submitted within <u>6 months</u> after the acceptance of the Inception report.	10%
3.	Final report: The report should contain the data of interim report, Environmental impact assessment, cost estimate and the project progress/milestones (PERT/CPM chart), Fund requirements , software development etc all complete. The final report will be submitted within <u>2 months</u> after the acceptance of the Interim Report.	10%
4.	Providing assistance in getting the scheme sanctioned within <u>1 month</u> after acceptance of the Final report.	5%
5.	Tender Document: The tender document to be prepared as per the rules and regulation of the department. The Tender document should be submitted within <u>2 months</u> after the scheme getting sanctioned from GOI.	5%
6.	Tender Evaluation Report (Technical): The consultant will assist the department in preparation of the evaluation report as per the provision of contract. The tender evaluation report should be submitted within <u>2 months</u> after opening of the technical bid.	5 %
7.	Project management Consultancy for the entire duration of the project during the execution of the project with 15 year software maintenance / upgradation for the effective control on the functions of electromechanical equipments through web. The amount is payable in 15 years.	60%

The consultant may pray for the change of payment schedule . The change will be effective only after the approval of Engineer in Chief .

**Engineer in Chief
Drinking water And Sanitation department
Nepal House , Ranchi**

8. ANNEXURES

Bidders may go through Paragraphs-1 to -7 and the annexures to this document before filling in the rates.

ANNEXURE 1**Criteria for evaluation of Technical Bid**

Technical evaluation will be carried out on the basis of information supplied by the bidders as per formats attached and/ or independent enquiries by the employer using the following criteria:-

Total Marks - 100

Sl. No.	Particulars	Marks
	A. <u>DB experience (Max. 30 marks)</u>	
1.	<u>Organizational Status (Max 3 marks)</u>	
	i. Proprietary firm	1
	ii. Partnership firm	2
	iii. Pub/ Pvt Ltd. Company	3
2.	<u>Financial Status (Max 10 marks)</u>	
	i. Annual financial turn over for Civil works in last 5 years to be adjusted For cost increase by 10%.	
	(a) Average of last 5 years	
	50 crore	3
	50 crore to 75 crore	4
	> 75 crore	5
	(b) Minimum in last 5 years	
	100 crore	3
	100 crore to 150 crore	4
	> 150 crore	5
3.	<u>Similar Work Experience (Max. 10 marks)</u>	
	i. 50 crore	6
	ii. 50 crore to 100 crore	8
	iii. > 100 crore	10

4. **Bid capacity (Max. 7 marks)**

i.	100 crore	3
ii	125 crore	5
iii	>125 crore	7

B. DB Work Plan (Max. 15 marks)

1. Drawing (Max. 15 marks)

i.	Site plan	4
ii.	Detailed narration	3
iii.	Detailed Work & Quality Assurance Plan	6
iv.	Itemized list of principal codes	2

C. Operation (Max. 55 Marks)

A. Work Plan (Max. 10 Marks)

I.	Operation Work Plan	5.0
II.	Methodology , approach	2.5
III.	Ability to meet tech. Standard	2.5

B. Experience (Max. 20 Marks)

I.	Formulation of Schemes upto 1000 MLd	10
II.	Formulation of Schemes upto 2000 MLd	12
III.	Formulation of Schemes upto 3000 MLd	15
IV.	Formulation of Schemes upto 3000 MLd with SCADA	20

C. Staffing (25 Marks)

I. Team Leader (10 Marks)

BE Civil + 10 year experience	5
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BE Civil + Additional 1 year experience

max. 15 years -

add 1 mark
for each year experience

II. Project Costing Expert (5 Marks)

BE Civil /Mech.+ 10 year experience 2.5

BE Civil + Additional 1 year experience

max. 15 years -

add 1 mark
for each year experience

III. Environmental Expert (5 Marks)

BE Civil /Mech.+ 7 year experience 2.5

BE Civil + Additional 1 year experience

max. 9 years -

add 1 mark

for each year experience

IV. Civil Engineers (2.5Marks)BE Civil /Mech. Or Dip Civil / Mech. + 5 year/
7 years exp.

1.5

BE Civil /Mech.(Or Dip Civil / Mech.) + 5 year

add 0.5 marks

Exp. (7 years exp.) + Additional 2 year exp.

For each year exp.

Max.

V. Software Experts (2.5 Marks)

BE Computer Science & Engineering. + 5 year

Exp. 7 years exp.

2.5

BE Computer Science & Engineering + 5 year

add 0.5 marks

Exp. (7 years exp.) + Additional 2 year exp.

For each year exp.

Engineer in Chief
Drinking water And Sanitation department
Nepal House , Ranchi

ANNEXURE-2

Jharkhand—State Profile

The state of Jharkhand became a functioning reality on 15 November 2000 after almost half a century of people's movements around Jharkhandi identity, which disadvantaged societal groups articulated to augment political resources and influence the policy process in their favour. Its the 28th state of India. The Jharkhandi identity and the demand for autonomy was not premised solely on the uniqueness of its tribal cultural heritage but was essentially a fallout of the failure of development policy to intervene in socio-economic conditions of the adivasis and non-adivasis in the region.

The dynamics of resources and the politics of development still influence the socio-economic structures in Jharkhand, which was carved out of the relatively 'backward' southern part of Bihar. According to the 1991 census, the state has a population of over 20 million out of which 28% is tribal while 12% of the people belong to scheduled castes. Jharkhand has 24 districts, 260 blocks and 32,620 villages out of which only 45% are electrified while only 8,484 are connected by roads. Jharkhand is the leading producer of mineral wealth in the country after Chattisgarh state, endowed as it is with vast variety of minerals like iron ore, coal, copper ore, mica, bauxite, graphite, limestone, and uranium. Jharkhand is also known for its vast forest resources.

Geography and climate

Geography

Most of the state lies on the Chota Nagpur Plateau, which is the source of the Koel, Damodar, Brahmani, Kharkai, and Subarnarekha rivers, whose upper watersheds lie within Jharkhand. Much of the state is still covered by forest. Forest preserves support populations of tigers and Asian Elephants.



Jonha Fall.



Hundru Fall.

Soil content of Jharkhand state mainly consist of soil formed from disintegration of rocks and stones, and soil composition is further divided into:

Red soil, found mostly in the Damodar valley, and Rajmahal area

Micacious soil (containing particles of mica), found in Koderma, Jhumri Telaiya, Barkagaon, and areas around the Mandar hill

Sandy soil, generally found in Hazaribagh and Dhanbad

Black soil, found in Rajmahal area

Laterite soil, found in western part of Ranchi, Palamu, Dumka and parts of Santhal Parganas and Singhbhum

Water retention capacity of soil is very less. At some point it retains rain water and it discharges it in the downstream. The ground water available in most of the cases is from the faults and fissures of the rock which has come to an alarming situation due to the excessive withdrawal from it. Now as the water source is depleting it has given a number of quality problems which is harmful for human health. That is why the dependence on surface source is the only remedy for survival.

Climate

There are three well-defined seasons in Jharkhand. The cold-weather season, from November to February, is the most pleasant part of the year. High temperatures in Ranchi in December usually rise from about 50 °F (10 °C) into the low 70s F (low 20s C) daily. The hot-weather season lasts from March to mid-June. May, the hottest month, is characterized by daily high temperatures in the upper 90s F (about 37 °C) and low temperatures in the mid-70s F (mid-20s C). Maximum rainfall takes place during the months from July to September that accounts for more than 90% of total rainfall in the state.

Flora and fauna

State symbols of Jharkhand

Formation day 15 November (Day of separation from Bihar)

State animal Elephant^[8]



State bird Koel



State tree Sal^[8]



State flower Palash^[8]



Jharkhand has a rich variety of flora and fauna. The National Parks and the Zoological Gardens located in the state of Jharkhand present a panorama of this variety.

Betla National Park in the Latehar district, located 8 km away from Barwadih, covers an area of about 250 square kilometres (97 sq mi). The national park has a large variety of wildlife, including tigers, elephants, bisons (which are locally known as gaurs), sambhars, wild boar, and pythons (up to 20 feet (6.1 m) long), spotted deer (chitals), rabbits and foxes. The mammalian fauna to be seen at

Betla National Park also include langurs, rhesus monkeys, blue bulls and wild boars. The lesser mammals are the porcupines, hares, wild cats, honey badgers, Malabar giant squirrels, mongooses, wolves, antelopes etc. In 1974, the park was declared a Project Tiger Reserve.

Part of the reason for the variety and diversity of flora and fauna found in Jharkhand state may be accredited to the Palamau Tiger Reserves under the Project Tiger. This reserve is abode to hundreds of species of flora and fauna,^[9] as indicated within brackets: mammals (39), snakes (8), lizards (4), fish (6), insects (21), birds (170), seed bearing plants and trees (97), shrubs and herbs (46), climbers, parasites and semi-parasites (25), and grasses and bamboos (17).

The Hazaribag Wildlife Sanctuary, with scenic beauties, 135 kilometres (84 mi) away from Ranchi, is set in an ecosystem very similar to Betla National Park of Palamu.

Jawaharlal Nehru Biological Park in Bokaro Steel City is the largest Zoological Garden in Jharkhand. It has many animal and bird species, spread over 200 acres (0.81 km²), including an artificial waterpark with boating facilities. Another zoo, Birsa Munda Jaiwik Udyan, is also located about 16 km from Ranchi, and a number of mammalian fauna have been collected there for visitors.



Santal women in Jharkhand,

Demography

Population Growth

Census	Pop.	%±
1951	9,697,000	—
1961	11,606,000	19.7%
1971	14,227,000	22.6%
1981	17,612,000	23.8%
1991	21,844,000	24.0%
2001	26,946,000	23.4%
2011	32,966,238	22.3%

Source: Census of India^[10]

Jharkhand has a population of 32.96 million, consisting of 16.93 million males and 16.03 million females. The sex ratio is 947 females to 1000 males. The population consists of 28% tribal peoples, 12% Scheduled Castes and 60% others. The population density of the state is 414 persons per square kilometre of land; it varies from as low as 148 per square kilometre in Gumla district to as high as 1167 per square kilometre in Dhanbad district.

As per the 2001 census Hinduism is followed by 68.5% of the population of Jharkhand. Islam is followed by 13.8% of the population and Animistic Sarna religion is practised by 13% of the population. Christianity with 4.1% of the population is the fourth largest religious community in Jharkhand. Jainism, Buddhism and Sikhism are all practiced making few less than 1%.

Census data since 1881 has shown a gradual decline of tribal population in Jharkhand as against the gradual increase of non-tribal population in the region. The reasons given for this are low birth rate and high death rate among the tribes; immigration of non-tribal peoples in the region; emigration of tribal peoples in the other places; and the adverse effects of industrialisation and urbanisation in the

region. Tribal leaders assert, however, that their numbers are not as low as recorded by the census that they are still in the majority and that they remain a demographic force to reckon with.

Few centuries ago, the Jharkhand was extensively covered with the dense sal Jharkhand terrain had always been inaccessible. But with the discovery of its hidden mineral wealth has led to Jharkhand marching towards becoming one of the leading industrialized regions of India. On the one hand, the mine-fields, railways and roadways have gone ahead rapidly, educational and technical institutions have multiplied and the principal towns have become cosmopolitan; while on the other hand, the tribal people of the region have been deprived of their land and the process of indiscriminate exploitation has set in, creating racial, nutritional, cultural and socio-economic problems.

From the first regular Indian census of 1872, tribal denominations of the population have been regularly recorded in some form or the other. The Schedules tribes have been last notified under the Government of India, Ministry of Home Affairs Notification issued under Article 341 (i) and 342 (ii) of the constitution in 1956.

During the first census of 1872 following 18 tribal communities were listed as the Aboriginal Tribes: (1) Asur, (2) Binjhia, (3) Gond, (4) Ho, (5) Kharia, (6) Kharwar, (7) Khond, (8) Kisan, (9) Korwa, (10) Mal Paharia, (11) Munda, (12) Oraon, (13) Santhal, (14) Sauria Paharia, (15) Savar, (16) Bhumij, (17) Birhor Chero.

Later 4 Tribes were classified as semi-Hinduized aboriginals, viz., (1) Banjara, (2) Bathundi, (3) Chik Baraik and (4) Mahli. As of now the following 30 communities of Jharkhand are listed as the Scheduled Tribes as per details in the state government's website.

Primitives Tribes: Asur, Birhor, Birajia, Korba, Mal Paharia, Sauriya Paharia, Sabar, Hill Kharia and Parahiya.

Other Tribes: Biga, Banjara, Bathudi, Bedia, Bhumij, Binjhia, Chero, Chik Baraik, Gond, Gorait, Ho, Karmali, Khadia, Kharwar, Khond, Kisan, Kora, Lohra, Mahali, Munda, Oraon and Santhal.

SON RIVER

The Son originates near [Amarkantak](#) in [Madhya Pradesh](#),^[1] just east of the headwater of the [Narmada River](#), and flows north-northwest through Madhya Pradesh state before turning sharply eastward where it encounters the southwest-northeast-running [Kaimur Range](#). The Son parallels the Kaimur hills, flowing east-northeast through [Uttar Pradesh](#), [Jharkhand](#) and [Bihar](#) states to join the Ganges just above [Patna](#). Geologically, the lower valley of the Son is an extension of the [Narmada Valley](#), and the Kaimur Range an extension of the [Vindhya Range](#). [Dehri on sone](#) is the major town situated on Son River.

The Son river at 784 kilometres (487 mi) long, is one of the largest rivers of India.^[1] Its chief tributaries are the [Rihand](#) and the [North Koel](#). The Son has a steep [gradient](#) (35–55 cm per km) with quick [run-off](#) and [ephemeral](#) regimes, becoming a roaring river with the rain-waters in the [catchment](#) area but turning quickly into a fordable stream. The Son, being wide and shallow, leaves disconnected pools of water in the remaining part of the year. The channel of the Son is very wide (about 5 km at [Dehri on sone](#)) but the [floodplain](#) is narrow, only 3 to 5 km wide. In the past, the Son has been notorious for changing course, as it is traceable from several old beds near its east bank. In modern times this tendency has been checked with the [anicut](#) at Dehri, and now more so with the [Indrapuri Barrage](#).

Sir John Houlton, the British administrator, describes the Son as follows, “After passing the steep escarpments of the [Kaimur range](#), it flows straight across the plain to the Ganges. For much of this distance it is over two miles – and at one point, opposite Tilothu – three miles wide. In the dry weather there is vast expanse of sand, with a stream not more than a hundred yards wide, and the hot west winds pile up the sand on the east bank, making natural embankments. After heavy rain in the hills even this wide bed cannot carry the waters of the Son and disastrous floods in Shahabad, Gaya, and Patna are not uncommon.”²¹

Ganges River

Ganges River, Hindi Ganga, great river of the plains of northern India. Although officially as well as popularly called the Ganga in Hindi and in other Indian languages, internationally it is known by its conventional name, the Ganges. From time immemorial it has been the holy river of Hinduism. For most of its course it is a wide and sluggish stream, flowing through one of the most fertile and densely populated regions in the world. Despite its importance, its length of 1,560 miles (2,510 km) is relatively short compared with the other great rivers of Asia or of the world.

Rising in the Himalayas and emptying into the Bay of Bengal, it drains a quarter of the territory of India, while its basin supports hundreds of millions of people. The Gangetic Plain, across which it flows, is the heartland of the region known as Hindustan and has been the cradle of successive civilizations from the Mauryan empire of Ashoka in the 3rd century BCE down to the Mughal Empire, founded in the 16th century.

For most of its course the Ganges flows through Indian territory, although its large delta in the Bengal area, which it shares with the Brahmaputra River, lies mostly in Bangladesh. The general direction of the river’s flow is from northwest to southeast. At its delta the flow is generally southward.

Physiography

The Ganges rises in the southern Himalayas on the Indian side of the border with the Tibet Autonomous region of China. Its five headstreams—the Bhagirathi, Alaknanda, Mandakini, Dhauliganga, and Pindar—all rise in the northern mountainous region of Uttarakhand state. Of these, the two main headstreams are the Alaknanda (the longer of the two), which rises about 30 miles (50 km) north of the Himalayan peak of Nanda Devi, and the Bhagirathi, which originates about 10,000 feet (3,000 metres) above sea level in a subglacial meltwater cave at the base of the Himalayan glacier known as Gangotri. Gangotri itself is a sacred place for Hindu pilgrimage. The true source of the Ganges, however, is considered to be at Gaumukh, about 13 miles (21 km) southeast of Gangotri.

The Alaknanda and Bhagirathi unite at Devaprayag to form the main stream known as the Ganga, which cuts through the Outer (southern) Himalayas to emerge from the mountains at Rishikesh. It then flows onto the plain at Haridwar, another place held sacred by the Hindus.

The volume of the Ganges increases markedly as it receives more tributaries and enters a region of heavier rainfall, and it shows a marked seasonal variation in flow. From April to June the melting Himalayan snows feed the river, while in the rainy season from July to September the rain-bearing monsoons cause floods. During winter the river’s flow declines. South of Haridwar, now within the

state of Uttar Pradesh, the river receives the principal right-bank tributaries of the Yamuna River, which flows through the Delhi capital region to join the Ganges near Allahabad, and the Tons, which flows north from the Vindhya Range in Madhya Pradesh state and joins the Ganges just below Allahabad. The main left-bank tributaries in Uttar Pradesh are the Ramganga, the Gomati, and the Ghaghara.

The Ganges next enters the state of Bihar, where its main tributaries from the Himalayan region to the north are the Gandak, the Burhi Gandak, the Ghugri, and the Kosi rivers and its most important southern tributary is the Son. The river then skirts the Rajmahal Hills to the south and flows southeast to Farakka, at the apex of the delta. In West Bengal, the last Indian state that the Ganges enters, the Mahananda River joins it from the north. In West Bengal in India, as well as in Bangladesh, the Ganges is locally called the Padma. The westernmost distributaries of the delta are the Bhagirathi and the Hugli (Hooghly) rivers, on the east bank of which stands the huge metropolis of Kolkata (Calcutta). The Hugli itself is joined by two tributaries flowing in from the west, the Damodar and the Rupnarayan. As the Ganges passes from West Bengal into Bangladesh, a number of distributaries branch off to the south into the river's vast delta. In Bangladesh the Ganges is joined by the mighty Brahmaputra (which is called the Jamuna in Bangladesh) near Goalundo Ghat. The combined stream, there called the Padma, joins with the Meghna River above Chandpur. The waters then flow through the delta region to the Bay of Bengal via innumerable channels, the largest of which is known as the Meghna estuary.

The Ganges-Brahmaputra system has the third greatest average discharge of the world's rivers, at roughly 1,086,500 cubic feet (30,770 cubic metres) per second; approximately 390,000 cubic feet (11,000 cubic metres) per second is supplied by the Ganges alone. The rivers' combined suspended sediment load of about 1.84 billion tons per year is the world's highest.

Dhaka (Dacca), the capital of Bangladesh, stands on the Buriganga ("Old Ganges"), a tributary of the Dhaleswari. Apart from the Hugli and the Meghna, the other distributary streams that form the Ganges delta are, in West Bengal, the Jalangi River and, in Bangladesh, the Matabhanga, Bhairab, Kabadak, Garai-Madhumati, and Arial Khan rivers.

The Ganges, as well as its tributaries and distributaries, is constantly vulnerable to changes in its course in the delta region. Such changes have occurred in comparatively recent times, especially since 1750. In 1785 the Brahmaputra flowed past the city of Mymensingh; it now flows more than 40 miles (65 km) west of it before joining the Ganges.

The delta, the seaward prolongation of sediment deposits from the Ganges and Brahmaputra river valleys, is about 220 miles (355 km) along the coast and covers an area of about 23,000 square miles (60,000 square km). It is composed of repeated alternations of clays, sands, and marls, with recurring layers of peat, lignite, and beds of what were once forests. The new deposits of the delta, known in Hindi and Urdu as the khadar, naturally occur in the vicinity of the present channels. The delta's growth is dominated by tidal processes.

The southern surface of the Ganges delta has been formed by the rapid and comparatively recent deposition of enormous loads of sediment. To the east the seaward side of the delta is being changed at a rapid rate by the formation of new lands, known as chars, and new islands. The western coastline of the delta, however, has remained practically unchanged since the 18th century.

The rivers in the West Bengal area are sluggish; little water passes down them to the sea. In the Bangladeshi delta region, the rivers are broad and active, carrying plentiful water and connected by innumerable creeks. During the rains (June to October) the greater part of the region is flooded to a depth of 3 or more feet (at least 1 metre), leaving the villages and homesteads, which are built on artificially raised land, isolated above the floodwaters. Communication between settlements during this season can be accomplished only by boat.

To the seaward side of the delta as a whole, there is a vast stretch of tidal mangrove forests and swampland. The region, called the Sundarbans, is protected by India and Bangladesh for conservation purposes. Each country's portion of the Sundarbans has been designated a UNESCO World Heritage site, India's in 1987 and Bangladesh's in 1997.

In certain parts of the delta there occur layers of peat, composed of the remains of forest vegetation and rice plants. In many natural depressions, known as bils, peat, still in the process of formation, has been used as a fertilizer by local farmers, and it also has been dried and used as a domestic and industrial fuel.

Climate and hydrology

The Ganges basin contains the largest river system on the subcontinent. The water supply depends partly on the rains brought by the southwesterly monsoon winds from July to October, as well as on the flow from melting Himalayan snows in the hot season from April to June. Precipitation in the river basin accompanies the southwest monsoon winds, but it also comes with tropical cyclones that originate in the Bay of Bengal between June and October. Only a small amount of rainfall occurs in December and January. The average annual rainfall varies from 30 inches (760 mm) at the western end of the basin to more than 90 inches (2,290 mm) at the eastern end. (In the upper Gangetic Plain in Uttar Pradesh, rainfall averages about 30–40 inches [760–1,020 mm]; in the Middle Ganges Plain of Bihar, from 40 to 60 inches [1,020 to 1,520 mm]; and in the delta region, between 60 and 100 inches [1,520 to 2,540 mm].) The delta region experiences strong cyclonic storms both before the commencement of the monsoon season, from March to May, and at the end of it, from September to October. Some of these storms result in much loss of life and the destruction of homes, crops, and livestock. One such storm, which occurred in November 1970, was of catastrophic proportions, resulting in deaths of at least 200,000 and possibly as many as 500,000 people; another, in April 1991, killed some 140,000.

Since there is little variation in relief over the entire surface of the Gangetic Plain, the river's rate of flow is slow. Between the Yamuna River at Delhi and the Bay of Bengal, a distance of nearly 1,000 miles (1,600 km), the elevation drops only some 700 feet (210 metres). Altogether the Ganges-Brahmaputra plains extend over an area of 300,000 square miles (800,000 square km). The alluvial mantle of the plain, which in some places is more than 6,000 feet (1,800 metres) thick, is possibly not more than 10,000 years old.

Plant and animal life

The Ganges-Yamuna area was once densely forested; historical writings indicate that in the 16th and 17th centuries wild elephants, buffalo, bison, rhinoceroses, lions, and tigers were hunted there.

Most of the original natural vegetation has disappeared from the Ganges basin, and the land is now intensely cultivated to meet the needs of an ever-growing population. Large wild animals are few, except for deer, boars, and wildcats and some wolves, jackals, and foxes. Only in the Sundarbans area of the delta are some Bengal tigers, crocodiles, and marsh deer still found. Fish abound in all the rivers, especially in the delta area, where they form an important part of the inhabitants' diet. Many varieties of birds are found, such as mynah birds, parrots, crows, kites, partridges, and fowls. In winter, ducks and snipes migrate south across the high Himalayas, settling in large numbers in water-covered areas. In the Bengal area common fish include featherbacks (Notopteridae family), barbs (Cyprinidae), walking catfish, gouramis (Anabantidae), and milkfish (Chanidae).

People

Ethnically, the people of the Ganges basin are of mixed origin. In the west and centre of the basin they were originally descended from an early population—possibly speaking Dravidian or Austroasiatic languages—and were later joined by speakers of Indo-Aryan languages. In historical times, Turks, Mongols, Afghans, Persians, and Arabs came from the west and intermingled with them. To the east and south, especially in Bengal, peoples speaking Austroasiatic, Indo-Aryan, and Tibeto-Burman languages have joined the population over the centuries. Europeans, arriving still later, did not settle or intermarry to any large extent.

Historically the Gangetic Plain has constituted the heartland of Hindustan and its successive civilizations. The centre of the Mauryan empire of Ashoka was Patna (ancient Pataliputra), on the Ganges in Bihar. The centres of the great Mughal Empire were at Delhi and Agra, in the western Ganges basin. Kannauj on the Ganges, north of Kanpur, was the centre of the feudal empire of Harsha, which covered most of northern India in the middle of the 7th century. During the Muslim era, which began in the 12th century, Muslim rule extended not only over the plain but overall Bengal as well. Dhaka and Murshidabad in the delta region were centres of Muslim power.

The British, having founded Calcutta (Kolkata) on the banks of the Hugli River in the late 17th century, gradually expanded their dominion up the valley of the Ganges, reaching Delhi in the mid-19th century.

A great number of cities have been built on the Gangetic Plain. Among the most notable are Saharanpur, Meerut, Agra (the city of the famous Taj Mahal mausoleum), Mathura (esteemed as the birthplace of the Hindu god Krishna), Aligarh, Kanpur, Bareilly, Lucknow, Allahabad, Varanasi (Benares; the holy city of the Hindus), Patna, Bhagalpur, Rajshahi, Murshidabad, Kolkata, Haora (Howrah), Dhaka, Khulna, and Barisal.

In the delta, Kolkata and its satellite towns stretch for about 50 miles (80 km) along both banks of the Hugli, forming one of India's most important concentrations of population, commerce, and industry.

The religious importance of the Ganges may exceed that of any other river in the world. It has been revered from the earliest times and today is regarded as the holiest of rivers by Hindus. While places of Hindu pilgrimage, called tirthas, are located throughout the subcontinent, those that are situated on the Ganges have particular significance. Among these are the confluence of the Ganges and the Yamuna near Allahabad, where a bathing festival, or mela, is held in January and February; during this ceremony hundreds of thousands of pilgrims immerse themselves in the river. Other holy places

for immersion are at Varanasi (Benares), or Kashi, and at Haridwar. The Hugli River at Kolkata also is regarded as holy.

Other places of pilgrimage on the Ganges include Gangotri and the junction of the Alaknanda and Bhagirathi headstreams in the Himalayas. The Hindus cast the ashes of their dead upon the river, believing that this gives the deceased direct passage to heaven, and cremation ghats (temples at the summit of riverside steps) for burning the dead have been built in many places on the banks of the Ganges.

Economy

Irrigation

Use of the Ganges water for irrigation, either when the river is in flood or by means of gravity canals, has been common since ancient times. Such irrigation is described in scriptures and mythological books written more than 2,000 years ago. Megasthenes, a Greek ambassador who was in India, recorded the use of irrigation in the 4th century BCE. Irrigation was highly developed during the period of Muslim rule from the 12th century onward, and the Mughal kings later constructed several canals. The canal system was further extended by the British.

The cultivated area of the Ganges valley in Uttar Pradesh and Bihar benefits from a system of irrigation canals that has increased the production of such cash crops as sugarcane, cotton, and oilseeds. The older canals are mainly in the Ganges-Yamuna Doab (doab meaning "land between two rivers"). The Upper Ganga Canal and its branches have a combined length of 5,950 miles (9,575 km); it begins at Haridwar. The Lower Ganga Canal, extending 5,120 miles (8,240 km) with its branches, begins at Naraura. The Sarada Canal irrigates land near Ayodhya, in Uttar Pradesh. Higher lands at the northern edge of the plain are difficult to irrigate by canal, and groundwater must be pumped to the surface. Large areas in Uttar Pradesh and in Bihar are also irrigated by channels running from hand-dug wells. The Ganges-Kabadak scheme in Bangladesh, largely an irrigation plan, covers parts of the districts of Khulna, Jessore, and Kushtia that lie within the part of the delta where silt and overgrowth choke the slowly flowing rivers. The system of irrigation is based on both gravity canals and electrically powered lifting devices

Navigation

In ancient times the Ganges and some of its tributaries, especially in the east, were important transportation routes. According to the ancient Greek historian Megasthenes, the Ganges and its main tributaries were being navigated in the 4th century BCE. In the 14th century, inland-river navigation in the Ganges basin was still flourishing. By the 19th century, irrigation-cum-navigation canals formed the main arteries of the water-transport system. The advent of paddle steamers revolutionized inland transport, stimulating the growth of indigo production in Bihar and Bengal. Regular steamer services ran from Kolkata up the Ganges to Allahabad and far beyond, as well as to Agra on the Yamuna and up the Brahmaputra River.

The decline of large-scale water transport began with the construction of railways during the mid-19th century. The increasing withdrawal of water for irrigation also affected navigation. River traffic now is insignificant beyond the middle Ganges basin around Allahabad, mainly consisting of rural rivercraft (including motorboats, sailboats, and rafts).

West Bengal and Bangladesh, however, continue to rely on the waterways to transport jute, tea, grain, and other agricultural and rural products. Principal river ports are Chalna, Khulna, Barisal, Chandpur, Narayanganj, Goalundo Ghat, Sirajganj, Bhairab Bazar, and Fenchuganj in Bangladesh and Kolkata, Goalpara, Dhuburi, and Dibrugarh in India. The partition of British India into India and Pakistan in 1947—with eastern Bengal becoming East Pakistan until in 1971 it declared its independence as Bangladesh—produced far-reaching changes, virtually halting the large trade in tea and jute formerly carried to Kolkata from Assam by inland waterway.

In Bangladesh inland water transport is the responsibility of the Inland Water Transport Authority. In India the Central Inland Water Transport Board formulates policy for inland waterways, while the Inland Waterways Authority develops and maintains an extensive system of national waterways. Approximately 1,000 miles (1,600 km) of waterways in the Ganges basin from Allahabad to Haldia are included in the system.

The Farakka Barrage at the head of the delta, just inside Indian territory in West Bengal, began diverting Ganges waters south into India in 1976. The Indian government argued that hydrological changes had diverted Ganges water from the port of Kolkata over the preceding century and resulted in the deposition of silt and the intrusion of saline seawater. India constructed the dam to ameliorate the condition of Kolkata by flushing away the seawater and raising the water level. The Bangladeshi government maintained that the Farakka Barrage deprived southwestern Bangladesh of a needed source of water. In 1996 both countries signed an agreement resolving the dispute by apportioning the waters of the Ganges between the two countries. Catastrophic floods in Bangladesh in 1987 and 1988—the latter being among the most severe in the country's history—prompted the World Bank to prepare a long-term flood-control plan for the region.

TECHNICAL DETAILS

The Ganges follows an 800-kilometre (500 mi) arching course passing through the cities of Kannauj, Farukhabad, and Kanpur. Along the way it is joined by the Ramganga, which contributes an average annual flow of about 500 m³/s (18,000 cu ft/s). The Ganges joins the Yamuna at the Triveni Sangam at Allahabad, a holy confluence in Hinduism. At their confluence the Yamuna is larger than the Ganges, contributing about 2,950 m³/s (104,000 cu ft/s),^[21] or about 58.5% of the combined flow.^[22]

Now flowing east, the river meets the Tamsa River (also called Tons), which flows north from the Kaimur Range and contributes an average flow of about 190 m³/s (6,700 cu ft/s). After the Tamsa the Gomti River joins, flowing south from the Himalayas. The Gomti contributes an average annual flow of about 234 m³/s (8,300 cu ft/s). Then the Ghaghara River, also flowing south from the Himalayas, joins. The Ghaghara, with its average annual flow of about 2,990 m³/s (106,000 cu ft/s), is the largest tributary of the Ganges. After the Ghaghara confluence the Ganges is joined from the south by the Son River, contributing about 1,000 m³/s (35,000 cu ft/s). The Gandaki River, then the Kosi River, join from the north, contributing about 1,654 m³/s (58,400 cu ft/s) and 2,166 m³/s (76,500 cu ft/s), respectively. The Kosi is the third largest tributary of the Ganges, after the Ghaghara and Yamuna.^[21]

Along the way between Allahabad and Malda, West Bengal, the Ganges passes the towns of Chunar, Mirzapur, Varanasi, Ghazipur, Patna, Bhagalpur, Ballia, Buxar, Simaria, Sultanganj, and Saidpur. At Bhagalpur, the river begins to flow south-southeast and at Pakur, it begins its attrition with the branching away of its first distributary, the Bhāgirathi-Hooghly, which goes on to become the Hooghly River. Just before the border with Bangladesh the Farakka Barrage controls the flow of the Ganges,

diverting some of the water into a feeder canal linked to the Hooghly for the purpose of keeping it relatively silt-free. The Hooghly River is formed by the confluence of the Bhagirathi River and Jalangi River at Nabadwip, and Hooghly has a number of tributaries of its own. The largest is the Damodar River, which is 541 km (336 mi) long, with a drainage basin of 25,820 km² (9,970 sq mi).^[23] The Hooghly River empties into the Bay of Bengal near Sagar Island.^[24] Between Malda and the Bay of Bengal, the Hooghly river passes the towns and cities of Murshidabad, Nabadwip, Kolkata and Howrah.

After entering Bangladesh, the main branch of the Ganges is known as the Padma. The Padma is joined by the Jamuna River, the largest distributary of the Brahmaputra. Further downstream, the Padma joins the Meghna River, the second largest distributary of the Brahmaputra, and takes on the Meghna's name as it enters the Meghna Estuary, which empties into the Bay of Bengal.

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