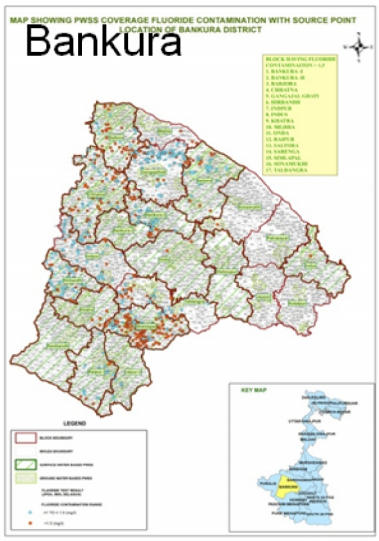
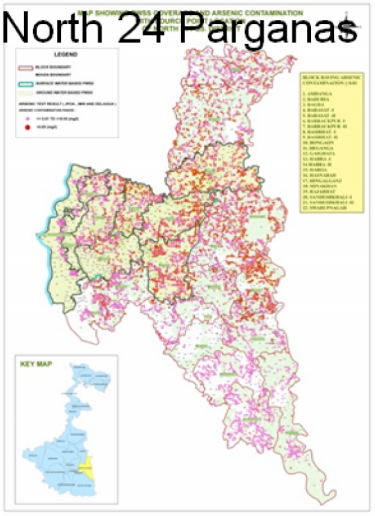
West Bengal Drinking Water Sector Improvement Project

With
Assistance from
Asian Development Bank

BANKURA DISTRICT

DRINKING WATER QUALITY ACTION PLAN





Public Health Engineering Department
Government of West Bengal

Table of Contents

List of Tables

List of Figures

List of Annexure

List of Abbreviations

BRGF	Backward Regions Grant Fund
C.D.	Community Development
CGWB	Central Ground Water Board
DDWS	Department of Drinking Water and Supply
GIS	Geographical Information System
GoI	Government of India
GoWB	Government of West Bengal
IHHL	Individual Household Latrine
IMIS	Integrated Management Information System
MIS	Management Information System
MoDWS	Ministry of Drinking Water and Sanitation
NRDWP	National Rural Drinking Water Program
ODF	Open Defecation Free
PHED	Public Health Engineering Department
PRI	Panchayet Raj Institution
PWD	Public Works Department
PWSS	Piped Water Supply Scheme
SFD	Shit Flow Diagram
SWID	State Water and Investigation Department
TDS	Total Dissolved Solids
VWSC	Village Water and Sanitation Committee
WRIDD	Water Resource Investigation and Development Department
WSSO	Water and Sanitation Support Organization
SCADA	Supervisory Control and Data Acquisition

Chapter 1 Background and Introduction

1.1 Background to the Program

A large part of India's population is dependent on groundwater as the major source of potable water. Contamination of groundwater, especially by naturally elevated inorganic contaminants like arsenic and fluoride, is a major issue in parts of the country, potentially leading to serious health hazards for the affected populations. Prolonged exposure to excess arsenic in drinking water may lead to keratosis, melanosis and cancer, while exposure to excess fluoride may lead to dental, skeletal and non-skeletal fluorosis. The total population at risk with respect to Arsenic and Fluoride Contamination is estimated at around 21.45 million as of August 2016[1].

With respect to arsenic, as per the older permissible limit of 0.05 mg/l under the Bureau of Indian Standards (BIS), 1724 [2]habitations in 7 States are affected by arsenic. Under the recently revised permissible limit of 0.01 mg/l, the number of arsenic affected habitations anticipated is assessed to be 12,456 and the population at risk is estimated to be around 13.0 million as of August 2016. The Arsenic affected habitations are primarily concentrated in the older alluvial deposits of Ganges and Bramhaputra. An assessed 92% of the arsenic affected population are concentrated in the States of West Bengal, Assam and Bihar.

There are about 13,736 fluoride affected habitations, above the 1.5mg/l permissible limit spread across 17 states, in India, and the total population affected is estimated to be 8.5 Million. Most of the Fluoride affected habitations are scattered. However, the States of Rajasthan, Telengana, Bihar, West Bengal, Haryana, Jharkhand and Karnataka account for more than 80% of the population affected by Fluoride Contamination.

Sustainable and permanent solutions in the form of surface water based piped water supply or identification of clean groundwater sources are required for the arsenic and fluoride affected habitations. Many of these habitations are in far-flung and remote areas, far away from any fresh water source, making infrastructure creation and service delivery relatively expensive.

The Ministry of Drinking Water and Sanitation (MoDWS) has launched a national sub-mission for Sustainable Drinking Water Supply in Habitations affected by Arsenic and Fluoride Contamination in Groundwater to improve drinking water quality as a part of its ongoing National Rural Drinking Water Program (NRDWP).Government of India (GoI), through MoDWS, has prepared the submission and is committed to supporting the affected states in implementing programs to provide Arsenic and Fluoride free drinking water to the affected population by 2020, and is working with the states in identifying the measures to do so.

West Bengal is one of the States, critically affected by ground water contamination of both Arsenic and Fluoride. A whopping 69% of the total population affected by Arsenic contamination is from West Bengal, whereas it has 6% of the total population affected by Fluoride contamination.Details of Arsenic and Fluoride affected habitations is presented in Annexure-01.

In line with the national objectives**,** Government of West Bengal (GoWB) has decided to provide safe and acceptable drinking water supply in sufficient quantity to priority areas of **North 24 Parganas, Murshidabad**, Hoogly, and Bradhaman as the top four priority districts for **Arsenic mitigation** and**Bankura,** Birbhum, Dakshin Dinajpur and Uttar Dinajpur as priority districts for **Fluoride mitigation**. Details of District wise Habitations

[1]Data provided by Ministry of Drinking Water and Sanitation, India.
[2]It is a term used to define a group of families living in proximity to each other within a village. It could have a heterogenous or homogenous demographic pattern.

affected by Arsenic and Fluoride contamination in West Bengal is provided in Annexure-02

The District-wide Water Quality Action Plan provides a detailed account of the existing situational assessment including prevailing coverage of piped Water Supply including available water resources including interventions, challenges, risks and mitigation measures to prepare for a larger framework for priority funding and implementation of the projects for each identified district. The present document deals with Bankura district, one of the targeted areas for fluoride mitigation.

1.2 Rationale for the Program

In line with the national objectives, Government of West Bengal (GoWB) has decided to consistently ensure the availability of safe and acceptable drinking water supply in sufficient quantity to the district of Bankura, which has been affected by Fluoride contamination (10 of the 22 Blocks in Bankura are affected by Fluoride contamination). The need for comprehensive piped water supply was necessitated on account of the absence of [3]reliable and sustainable ground water sources, [4]poor coverage of piped water supply and also in the backdrop of social backwardness and[5]high tribal population.

The Public Health Engineering Department (PHED) prepared and submitted to GOI a Detailed Project Report for the first phase (with Select 14 [6]Blocks) under [7]Backward Regions Grant Fund (BRGF), for implementation of a comprehensive piped water supply system. Proposals for improvement of Water Supply in the remaining 8 Blocks, as such always remained a priority to maintain the overall equity and balance in the WS System.

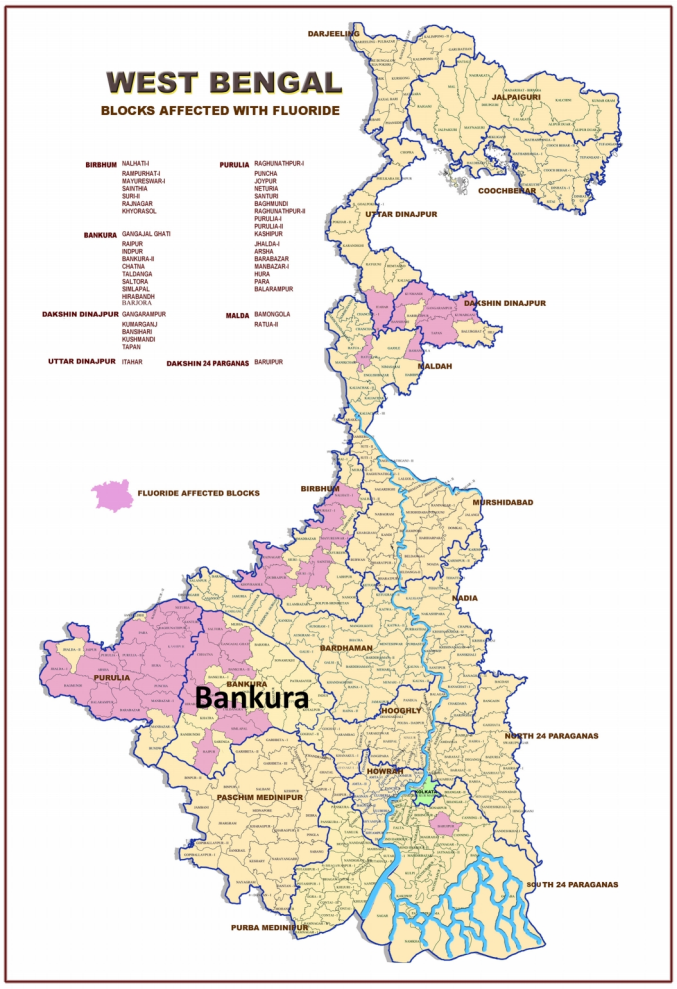


Figure 1: Fluoride Affected areas in West Bengal

[3] As per the Central Ground water Board Report, the blocks in the western part of the district have hydro-geological formations, which are unsuitable for large scale water abstraction.
[4]An assessed 4.6% of rural households in Bankura have treated tap water as per the District Census handbook for Bankura-2011
[5]An estimated 33.5% of rural population are Scheduled Castes and 11.5% belong to the Schedule Tribes as per the District Census handbook for Bankura-2011
[6]Administrative Unit within a District
[7]The Backward Regions Grant Fund (BRGF) is program designed to "address regional imbalances in development", launched by the Government of India.

1.3 Project Objectives

The primary objective of the NRDWP program as outlined by the MoDWS is to:

- To ensure, that every rural person has enough safe water for drinking, cooking and other domestic needs as well as livestock throughout the year including during natural disasters and,
- By 2022, every rural person in the country will have access to 70 lpcd within their household premises or at a horizontal or vertical distance of not more than 50 meters from their household without barriers of social or financial discrimination.

With the Objective of providing safe and adequate water, the Public Health Engineering Department, GoWB has taken up its most ambitious plan of "VISION 2020". The Vision incorporates among others:

- Ensuring sustainable water supply to each habitation to the tune of 70 lpcd (litres per capita per day) in rural West Bengal.
- Ensuring drinking water security through emphasis on piped water supply schemes with an objective to complete shift from hand pump tube-wells to piped water supply schemes in a phased manner, provision for house to house connection, conjunctive use of groundwater, surface-water and rain water harvesting.
- Delivery of services by the system for its entire design period of quality of water in conformity with the prescribed standards at both the supply and consumption points.
- Issue of potability, reliability, sustainability, convenience, equity and consumers preference to be the guiding principles while planning for a community based water supply system
- To enable communities to monitor and maintain surveillance on their drinking water sources;
- To ensure that all schools and [8]anganwadis have access to safe drinking water;
- To provide enabling environment for [9]Panchayat Raj Institutions and local communities to manage their own drinking water sources and systems;
- To provide access to information through online reporting mechanism with information placed in public domain to bring in transparency, accountability and informed decision making.

Overall the Program is intended to meet the requirements of "VISION 2020", endorsed by the GoWB and in line within the guidelines and implementation frame-work of NRDWP.

The West Bengal Water Supply Improvement Investment Program (WBWSIIP) is an initiative of the GoWB with funding from Asian Development Bank, to support them in their endeavor to fulfill the overarching goals of VISION-2020.

The development of Sustainable Water Supply Schemes in Bankura and comprehensive coverage of piped Water Supply Project is part of the larger West Bengal Water Supply Improvement Investment Program (WBWSIIP), aimed at fulfilling the objectives for the district of Bankura.

[8]Anganwadi means "courtyard shelter" in Indian languages. Anganwadis were started by the GoI as part of the Integrated Child Development Services program (In 1975) to combat child hunger and malnutrition. A typical Anganwadi centre provides basic health care in Indian villages.
[9]Panchayati Raj Institutions is a system of governance in which gram panchayats are the basic units of administration.The system has three levels: Village level is Gram Panchayat, Blocks level known as Block Samiti or Panchayat Samiti (block level), and District level known as Zila Parishad

1.4 Scope of the Report

The scope of the Water Quality Action Plan for the District of Bankura is to identify all interventions needed to implement the program for water supply improvement. It should be considered as a live document, to be updated as and when new data is available.

As the ground water in many parts of Bankura is contaminated with fluoride, the risks and costs of alternative surface and sub-surface sources should be evaluated with available alternatives (like ground water abstraction and treatment).

This WQAP provides the broad framework for developing the various WS Schemes that have already been developed and ensuring effective means of providing sustainable potable water supplies to the different blocks of Bankura.

The WQAP looks into the prevailing ground water quality data from the different blocks including the tests carried out under the aegis of WSSO (Water and Sanitation Support Organization), and suggests preventive measures that are required to reduce the impact arising out of possible ground water abstraction.

The MDWS has identified 5 strategic Objectives to achieve its goal:

Figure 2: Strategic Objectives

As such an initiative based on District wide approach has been taken in this “Drinking Water Quality Action Plan” to look at the overall issues related to Water Demand, available Surface / Sub-Sources / Ground Water Re-sources, Water quality, existing Schemes as well required investigations and monitoring required preparing a broad frame-work for implementation and monitoring of the Water Supply Schemes and provide a strategy for:

- Participatory Planning and Source Sustainability
- Water Quality Management and
- Sustainable Service Delivery
- for Bankura.

1.5 Project Stakeholders and Roles

The program will be conducted and managed by the Public Health Engineering Department, GoWB. Apart from PHED, the Panchayati Raj Institutions(The District Councils, Block Samitis etc) will have a significant role in the operation and maintenance of the Water Supply System, since the mandate to overlook and manage the distribution ends rests with the local communities, for which the formation of the Village Waterand Sanitation Committee has been initiated.

Successful implementation including management of the system would require close co-ordination between the various project stakeholders. The principle project stakeholders during implementation and thereafter for the project are shown below:

Public Health Engineering Department
Public Health Engineering Department (PHED) was created as an independent full-fledged Department in 1987. As per directives, Public Health Engineering Department is responsible for managing the Water Supply & Sanitation within the State including undertaking programmes of implementation of water supply and sanitation services through the Public Health Engineering Directorate under its administrative control.

Currently, however, Panchayet & Rural Development Department controls the Budget of Rural Sanitation and has been made the Nodal Department for Rural Sanitation. The Municipal Affairs and Urban Development Departments look after activities of Urban Sanitation and Sewerage Sector. The primary activities of the PHED are now related to Rural and Urban Water Supply Sectors.

Panchayats & Rural Development Department
Panchayats & Rural Development Department of the Government of West Bengal is entrusted with the responsibility of constitution and framing policy related to functioning of the rural local self-government, i.e, the Panchayats, providing administrative support to the three tier panchayat system as well as implementation of various rural development programmes. The associated local Zilla Parishads (District level governance), Panchayet Samitis (Block level governance) and Gram Panchayet (Village level governance) will be some of the stakeholders.

Water Resources Investigation and Development Department
The Objective of Water Resources Investigation and Development Department (WRIDD) is to explore, utilize and conserve Surface and Ground Water in the State of West by way of application of Technology & Technical know-how to cater the increasing demand of fresh water as well as to prevent degradation of water quality. The WRIDD is the mother Department and has 6 Department under its fold, of which the State Water and Investigation Directorate is an important stakeholders.

State Water Investigation Directorate (SWID),
SWID is responsible for carrying out investigation and quantitative & qualitative assessment of water resources in the State. It also shares expertise with various government developmental agencies in various groundwater and surface water projects for agriculture, industrial and drinking water development in the State including augmentation of water resources through implementation of various conservation/artificial recharge schemes and its key roles are in:

(a.) Periodical monitoring of groundwater level in different Blocks
(b.) Periodical monitoring of surface water discharge in different rivers
(c.) Groundwater Resources, Estimation and assessment
(d.) Assessment of GW & SW quality with respect to space and time
(e.) Delineation of aquifers containing salinity, arsenic, fluoride, iron and other heavy metals in groundwater
(f.) Evaluation of aquifer parameters through analysis & pumping tests data
(g.) Implementation of pilot schemes of artificial recharge to ground water,

(h.) Generation of hydro-meteorological data & its interpretation.
(i.) Preparation of District-wise and Block wise hydrogeological maps and groundwater resource feasibility maps.
(j.) Geophysical investigation of groundwater
(k.) Sharing technical expertise with to different Government Departments, Semi-Government Organizations, Local Self Bodies, Universities, WBSEB, Banks, individuals and groups of individuals in connection with surface water and groundwater development & management
(l.) Implementation of "West Bengal Ground Water Resources (Management, Control & Regulation) Act, 2005" in the state of West Bengal.

Irrigation and Waterways Department

The Irrigation and Waterways Department is entrusted with the task of providing irrigation facilities, offering reasonable protection against flood, alleviating drainage congestion, arresting erosion, maintaining internal navigation channels and up-keeping the natural waterways in the state. Both the Kangsabati and Durgapur barrage are under the control of the Department. The department has implemented several major and medium irrigation projects, number of embankment schemes, town protection Schemes, drainage schemes, antiriver-bank erosion schemes & anti sea-erosion Schemes.

Ministry of Drinking Water and Sanitation

The Ministry of Drinking Water and Sanitation, as the reforms initiator of NRDWP and funding partner, has a principal stake in preparation, monitoring and implementation of schemes.

There are also a number of secondary stakeholders like: the Pollution Control Board; Public Works Department (which overlooks the district and major roads); the National Highway Authority of India (NHAI); Land and Land Reforms Department;and Geological Survey of India. These could play a significant role in and during the process of conceptualization, implementation of the Schemes including in the Operation and Maintenance.

The development of a comprehensive plan for drinking water supply at a district level is expected to have a number of stakeholders who will be involved in the challenges associated with its implementation.

Chapter 2 District Profile

2.1 Location and Project area

2.1.1 Location

Bankura is located in the western part of the State of West Bengal. The District Bankura is bounded by latitude $22^0$38' N and longitude $86^0$36' E to $87^0$47' E. The Damodar flows along the northern boundary of the district. The district is bounded by Bardhaman in the north, Purulia in the west and Paschim Medinapure in the south.

The total area of Bankura is [10]6882 Sq. Kms. As per the latest Census data (2011), the population of the district is [11]3,596,674. It is the 3rd least populated district in West Bengal (After Alipurduar and Purulia, with Population Density of 523 persons / Sq. Kms.

The district has 22 Panchayet Samitis[12], with 190 Gram Panchayats[13], consisting of 3823 Villages and 6638 habitations.

The total number of urban centers is 12, of which 3 are Municipalities (Bankura, Bishnupur and Sonamukhi), and the remaining 9 are [14]Census towns, (Khatra, Ledisol, Jhanti Pahari, Kotulpur, Simlapal, Raipur Bazar, Ghutgarya, Barjora and Beliatore).

Figure 3: Bankura District Map

[10]As per http://bankura.gov.in/census.htm
[11]District Census Handbook-2011
[12]The Panchayat Samiti **is** the rural local-self government system at the block level. They form the middle level of the Panchayati Raj Institutions in India. It acts as a link between Village Panchayats (Gram Panchayats) and Zila Parishad (District council).Each district is divided into a number of blocks and each block consists of a number of adjoining villages (Gram Panchayat). For each block again there is a Panchayat Samiti.
[13]Gram Panchayat is the organization of elected members of Gram Sabha of the village. A Gram Sabha consists of members that include every adult of the village or Gram.

[14]Census Towns (CTs) are rural pockets with (a) A minimum population of 5000 (b) where, at least 75% of the male main working population engaged in non-agricultural pursuits and (c) have a density of population of at least 400 per sq.km

2.1.2 Administrative Divisions

Bankura district has 22 Blocks, divided into 3 Sub-divisions, namely Bankura Sadar, Khatra and Bishnupur.

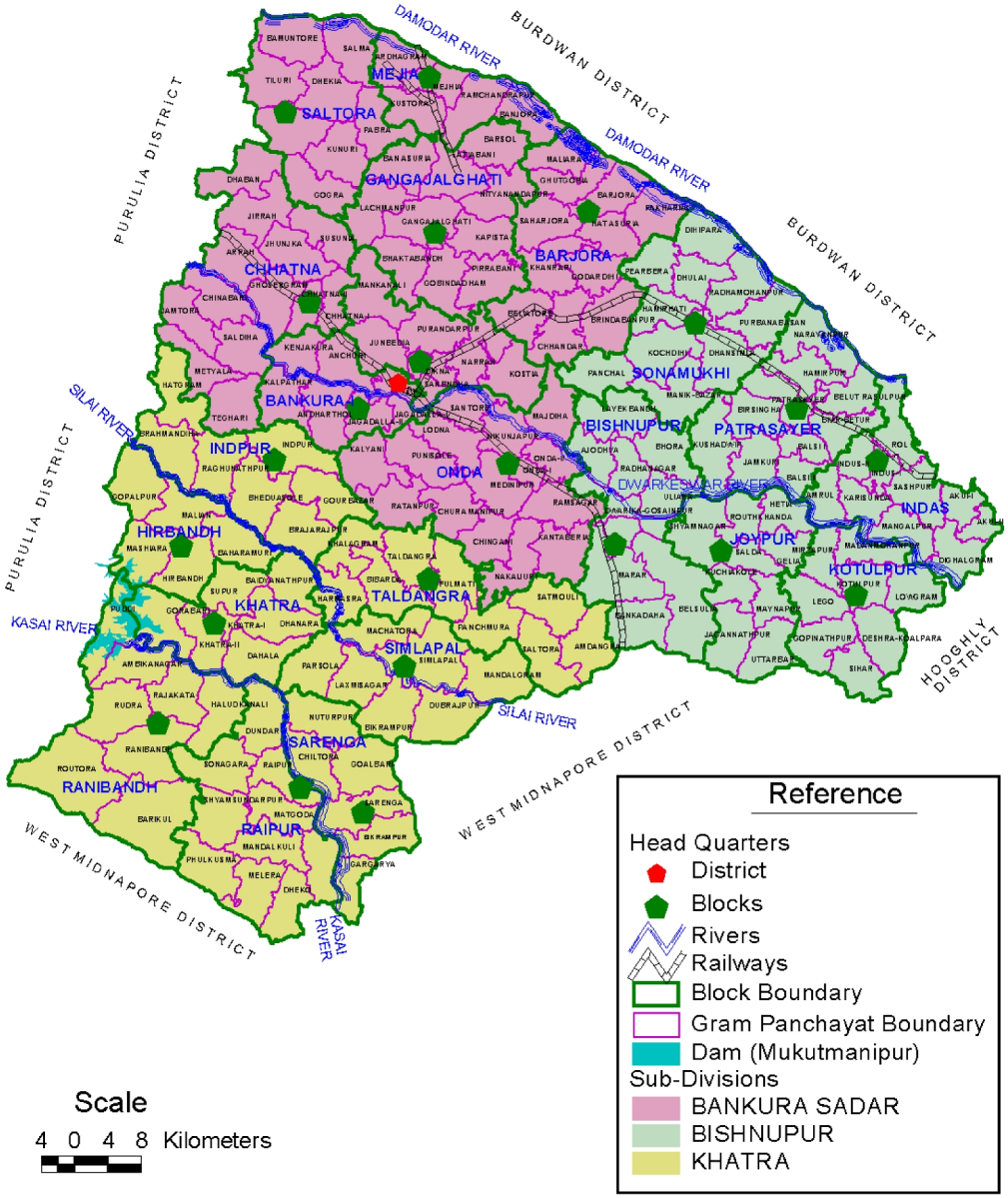


Figure 4: Administrative Sub-Divisions and Blocks of Bankura

The details of Blocks within each Sub-division and the Municipalities are tabled below:

Table 2-1: Administrative Division: Bankura

Sl. No.	Sub-Division	Block Details	Municipality
1	Bankura Sadar	Bankura-I, Bankura-II, Barjora, Chhatna, Gangajalghati, Mejia, Onda and Saltora	Bankura
2	Khatra	Indpur, Khatra, Hirbandh, Raipur, Sarenga, Ranibundh, Simlapal and Taldangra	-
3	Bishnupur	Indas, Joypur, Patrasayer, Kotulpur, Sonamukhi and Bishnupur	Bishnupur and Sonamukhi

2.1.3 **Road Network and Connectivity**

The Road Network of Bankura, showing the prominent roads is shown below:

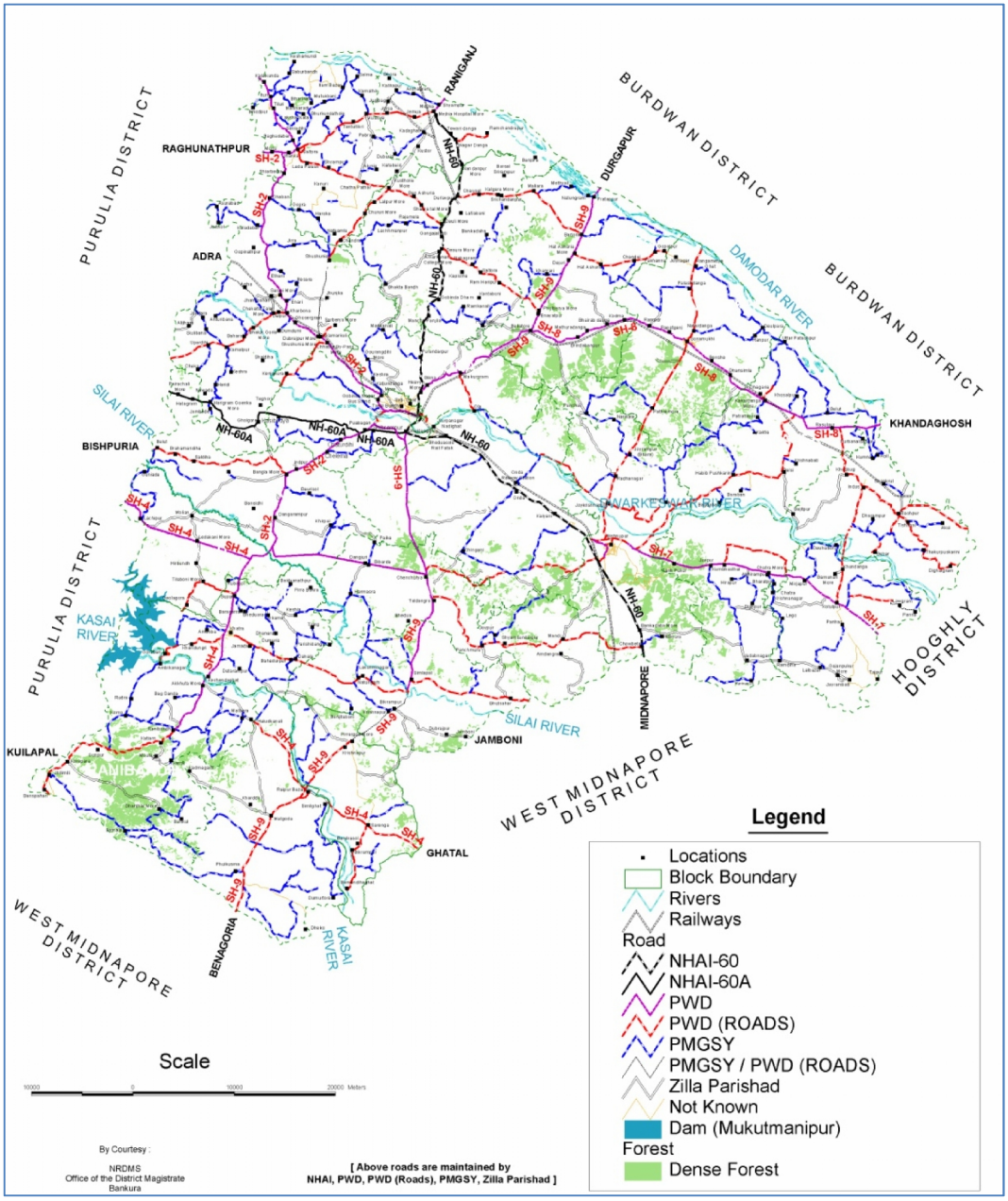


Figure 5: Rail and Road Connectivity: Bankura District

The critical importance of a road network and connectivity to the inhabited villages and in building up of a comprehensive piped water supply network is of paramount importance, considering the need to implement and maintain a sustainable water supply system. Details of the road network are given in Annexure-03.

While a good road network is appropriate to gain accessibility to the various habitations, a rail network normally creates impediments in the laying of pipeline across them. Bankura does not have an exhaustive rail network. However, it is well connected to Howrah (approximately 235 Kms) Bardhaman and Asansol.

2.1.4 Climate

Bankura is generally arid in nature compared to other parts of Bengal. Annual average rainfall in the district is 1400mm and the temperature varies from a maximum of (= >) 44^0C and minimum (of =<) 6^0C.The climate in the western portion of the district is drier than the eastern regions. From March to May, the hot westerly winds prevail and the day time temperatures are oppressive. The North-westers are frequent during the early part of March (locally called as “Kal Baisakhi”) and help to mitigate the excessive heat.

The rainy season sets during the month of June and lasts till September, but the climate is pleasant. The rainfall is maintained primarily by cyclonic storms, which originate from the Bay of Bengal, situated to the south-east.The rainfall recorded at the various metrological stations, in and around Bankura district during the winter, summer and rainy seasons is tabled below:

Table 2-2: Rainfall Data recorded in various metrological stations in Bankura

Sl. No	Station	Years recorded	Rainfall in Bankura District (In mm)			
			November to February	March to May	June to October	Average Annual
1	Bankura	43 - 46	50.8	169.7	1207.5	1428.0
2	Bishnupur	21 - 22	50.0	200.9	1234.2	1485.1
3	Gangajalghati	15 - 16	45.2	147.1	1185.7	1378.0
4	Indus	16 - 17	43.2	209.3	1128.8	1381.3
5	Khatra	20 - 21	52.1	159.3	1293.9	1505.3
6	Kotulpur	16 - 17	47.5	172.7	1170.9	1391.1
7	Mejhia	20 - 21	36.3	134.6	1125.7	1296.6
8	Onda	16 - 17	34.8	131.8	1116.3	1282.9
9	Raipur	15 - 16	47.8	203.7	1300.2	1551.7
10	Sonamukhi	15 - 16	51.3	166.6	1119.1	1337.0
Average			**46.0**	**169.7**	**1188.2**	**1403.6**

The winter sets in November and extends till February and the temperatures during the period are far more pleasant and enjoyable.

2.2 Physiography

2.2.1 Topography

Topographically the district of Bankura is divided into 6 micro regions viz.

1. Main Bankura Upland – characterized by undulating terrain with many hills and ridges along the north-western boundary of the district and having a gradual descent from the Chhatonagpur plateau.
2. Bankura Upland – continuation from the main Bankura Upland lies over a small tract in the south-east corner.
3. Bankura–Bishnupur Radh Plain – the elevation rises gradually in undulating surface but abruptly in hilly tract towards west extending between western hilly tract and eastern alluvial plains. The hillocks range in the region from 90 to 180 metres respectively.
4. Patrasayer Plain – a fertile plain area with a gradual slope towards south-west located in the north-east part.
5. Silai Plain – a plain area with few undulations in the west which extends till to the south-central part.
6. Middle Kasai Basin – mainly a plain area shaped by the Kasai river flowing from north-west to south-east and covers the north-western part of the district.

The average elevation of the district from mean sea level is 448 metres.

2.2.2 **Soil Charecteristics**

Soil of Bankura district can be broadly grouped into three principal types

(1) Red Soil
(2) Alluvial Soil and
(3) Laterite Soil.

Typical red soil has limited distribution in the south central, south-eastern and south western parts of the district around Bishnupur, Kotulpur and Raipur blocks respectively. These are the red coloured sedimentary soils (i.e. formed from residual parent materials) found mainly on laterites supporting Sal vegetation. They are also found along the margins of small hills bare of vegetation. Brown soils form a group within this class which are also sedimentary in nature, mainly derived from rocks like sandstone, granite gneiss and schists.

The alluvial soils, which have wide distribution in the east-central and southeastern parts of the district, are grouped according to soil association as Damodar-Rajmahal riverine, Damodar flatlands, Damodar highlands etc. The older alluvial amongst them is unaffected by floods and siltation and show profile development, whereas the younger or newer alluvial, found mostly in the Damodar flatland areas are enriched by silt deposition during floods. Such areas are characterised by high water table, a heavy sub-soil and occurrence of brown concretion at lower depths.

The laterite soils have wide distribution in the south-central to the south western part of the district. Such soils are distinguished from the red soils by the occurrence of ferruginous concretions in a definite layer, whereas in the red soils they are distributed throughout the profile.

2.2.3 Rivers and River Basin System of Bankura

The drainage / river basin system of Bankura is controlled primarily by the Damodar, Sali, Dwarekeshwar, Silabati and Kangshabati rivers. All the rivers have a south-easterly flow and the rivers are almost parallel to each other.

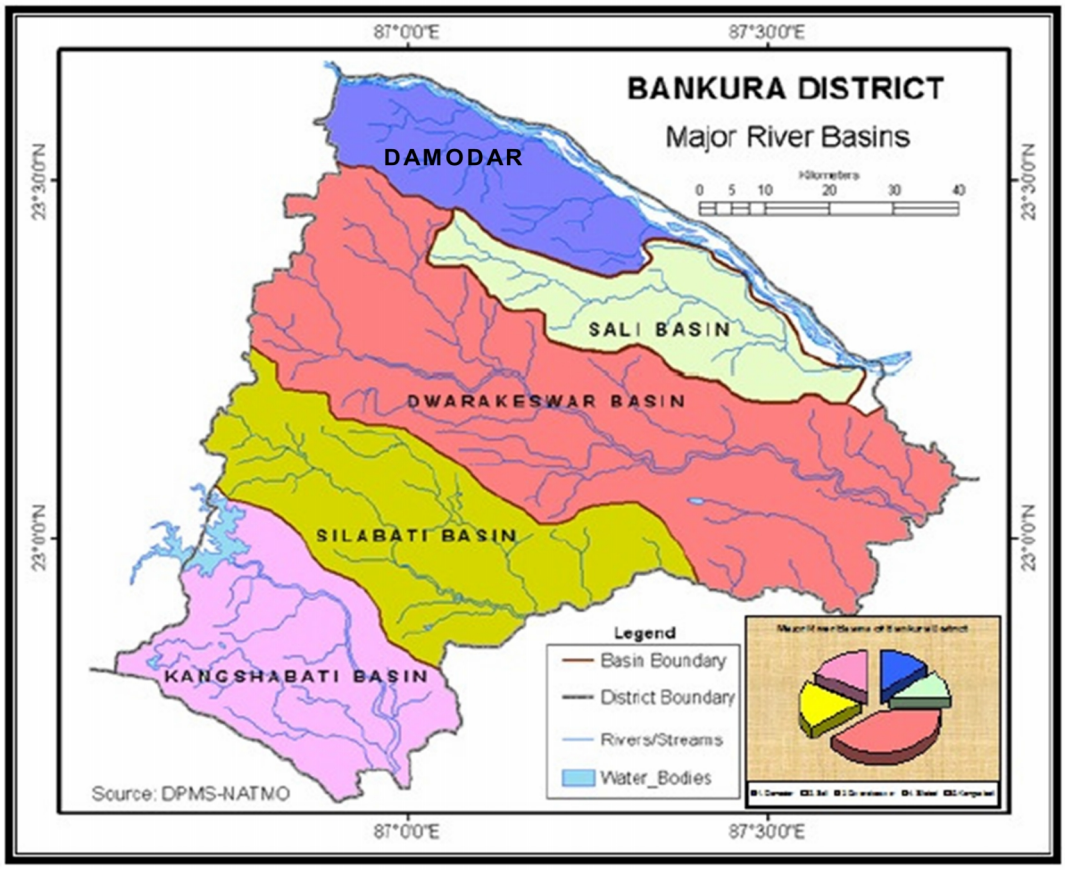


Figure 6: Drainage Basins of major rivers in Bankura

A brief discussion on each of the major rivers is outlined below:

2.2.3.1 Damodar

The Damodar river rises in the Palamu Hills of Chhotanagpur in Jharkhand at about 609mabove mean sea level. After flowing generally in a south-easterly direction for 540 km (240 km in Jharkhand and the rest in West Bengal) joins the river Hoogly about 50 km below Kolkata. Itsprincipal tributary, the Barakar, joins it just upstream of Jharkhand-West Bengal border. The Damodar has a number of tributaries and sub-tributaries, namely, Barakar, Konar, Bokaro,Haharo, Jamunia, Ghari, Guaia, Khadia and Bhera, with Barakar being the prime tributary.

The catchment area of the river is about 22,000 sq. km of which about 19,000 sq. km are in uplands and 3,000 sq. km in plains which are of deltaic nature. The catchment is irregular in shape and somewhat elongated in the lower reach. The river slope is 1.86 m/km for the first 241km;0.57 m/km in the next 167 km and 0.16 m/km in the last reach. Due to the particular topography of the catchment area, River Damodar used to inundate large tracts of districts of Burdwan, Hoogly and Howrah in the state of West Bengal every year.

To mitigate the recurrent floods, dams were constructed at Tilaiya (on Barakar-In 1953), Konar (On Konar River in 1955), Maithon (On Barakar in 1957) and Panchet (On Damodar in 1959).

The Maithon and Panchet act as control reservoirs and are located about 8km above the confluence point of Barakar joining the Damodar. A pick up structure-Durgapur barrage-was constructed downstream of the four dams later (In 1955) with head regulators for canals on either side for feeding an extensive system of canals and distributaries. One more reservoir-Tenughat (1978)-came up on Damodar river, constructed by Government of Bihar (Now, Jharkhand). The Tenughat dam is under control of Government of Jharkhand and Durgapur barrage under Government of West Bengal, rest of the dams are operated by Damodar Valley Corporation.

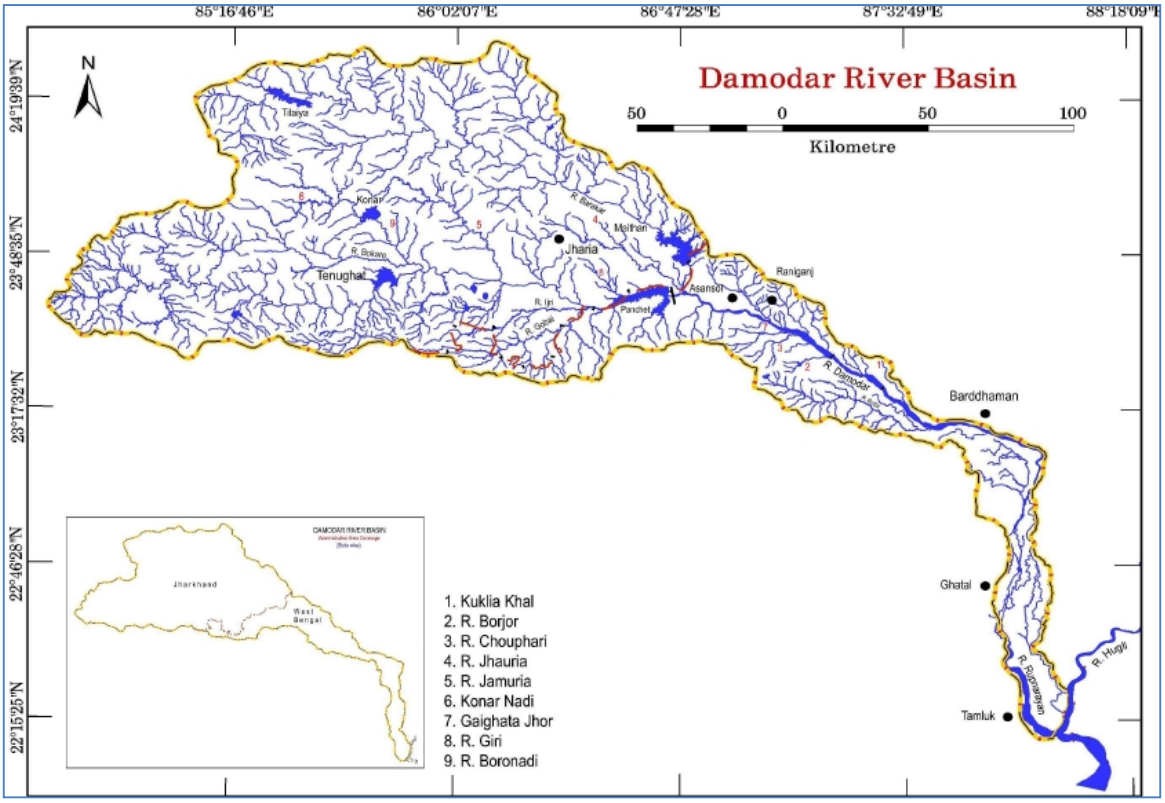


Figure 7: Damodar River Basin

An estimated 98.5 Kms of the Damodar is flowing through the northern edge of Bankura district. The major tributaries within the district are Kalighatam Jorh, Sali and Bodai.

2.2.3.2 Sali River

The Sali River is an important tributary of Damodar River that drains the northern part of Bankura district in the Indian state of West Bengal. It originates from a few miles west of Kora hill, halfway between Mejia and Bankura, and flows northwestern to south-eastern direction and meets the Damodar at Samsar village in Indas Block. The total length of the Sali river is 81 Kms.

2.2.3.3 Dwarekeshwar River

The most important river flowing through Bankura is the Dwarakeswar River. The river originates from Tilboni hills (445m), in neighboring Purulia district, entering Bankura near Chhatna. The total length of the river within Bankura is 132 Kms, and its catchment area is 4430 Sq. Kms.

The Silai (or Shilabati) is the largest tributary of Dwarakeswar and it joins Dwareshwar near Ghatal (In Paschim Mednipur), and the two together is known as Rupnarayan river, which flows through Hooghly. The other tributaries of Dwarakeswar River are the Gandheswari, the Kukhra, and the Berai.

2.2.3.4 Shilabati

The Silabati River (also known as Silai) originates in the terrain of the Chhota Nagpur Plateau (Puncha Block) in the Purulia district of the state ofWest Bengal in eastern India. It flows in an almost southeasterly direction through the districts of Bankura and West Midnapore. The length of the river within Bankura is 63 Kms.

There is a small reservoir on the Silabati near Khatra known as Kadam Deuli Dam wherea canal from Mukutmanipur-Kangsabati dam meets.The major tributaries are Joypanda, Purandar and Chamkakhali.

2.2.3.5 Kangsabati

Kangsabati River (also variously known as the Kasai and Cossye) rises from the Chota Nagpur plateau in the state of West Bengal, India and passes through the districts of Purulia, Bankura and Paschim Medinipur in West Bengal before draining in the Bay of Bengal.

After rising at Murguma near Jhalda in the Chota Nagpur plateau in Purulia district, it passes by Purulia, Khatra and Ranibandh inBankura district, and then enters Paschim Medinipur in the Binpur area. It is joined by Bhairabbanki. At Keshpur the river splits into two. The northern branch flows through the Daspur area as Palarpai and joins the Rupnarayan River. The other branch flows in a south-easterly direction and on joining the Kaliaghai River forms the Haldi River, which flows into the Bay of Bengal at Haldia.

The total length of the river within the district is 51 Kms. Major Tributaries are Bhairabanki and Tarafeni.

2.2.3.6 River Water Quality

The Central Pollution Control Board (CPCB)has been monitoring the water quality of different rivers in India. Water Quality Data was collected from 2500 water monitoring stations located on all important rivers under the National Water Monitoring Programme (NWMP). The water quality of the Damodar, Dwarakeshwar, Silabati does meet the water quality criteria with respect to pH, DO and conductivity, as per the CPCB report. Details of the water quality indicated wide fluctuations between the minimum and maximum values for faecal coliform and Total Coliform.

The data compiled also indicated that organic pollution (As indicated by the BoD and Coliform count) continued to be major water quality issue. Details of the Water Quality Test Results as available near Bankura are provided in Annexure-04.

2.2.4 Profile Charecteristics of the rivers

Though the rivers are seasonal, the river course in itself allows a huge potential for the Sub-surface water to be tapped. The extent of availability can be formalized only with requisite geo-hydrological study. While the need to harness the surface water flows of the rivers can well be understood, it must be appreciated that studies must also involve river water characteristics, particularly of credible importance is the shifting of rivers, which could critically affect any WS Scheme contemplated.

Papers and journals as available from Internet have been reviewed for the case specific section. Specific abstracts as found justified and applicable are presented in Annexure-05. The specific papers from which these have been sourced are presented in separately for understanding.

2.2.5 Dams and Barrages in or in the proximity of Bankura

2.2.5.1 Kangsabati Project

The Kangasabati Major Irrigation Project comprises of two dams across river Kangasabti and Kumari which is located near village Mukutmonipur, in Khatra district of Bankura. The two dams are connected by a hillock in between and forming continuous barrier with single reservoir, the valleys of Kangasabati and Kumari being connected by a link channel. The dam is earthen with concrete saddle spillway.[15] The length of the dam is 10.80km and maximum height of Kangasabati dam is 38.10 m and Kumari dam is 41.15 m. The reservoir gross storage capacity is 1053 Mcum and live storage capacity is 916.57 Mcum.

Figure 8: Kangsabati Reservoir Project Command area

The dam has two regulator supplying to a left bank feeder canal of 192 cumec design capacity and a right bank feeder canal of 70 cumec capacity. The left bank feeder after some distance bifurcates into two, the Supur main canal and the Khatra Main canal. Khatra main canal crosses the river Silabati through barrage (Silabati barrage), after which it is known as Indpur main canal. The right bank canal crosses the river Bhairabbanki and the river Tarafeni via two barrages (Tarafeni barrage & Bhairabbanki barrage) on these rivers.

[15]Reference: http://india-wris.nrsc.gov.in/wrpinfo/index.php?title=Kangsabati_Major_Irrigation_Project_JI02903

Details of the Kangsabati Reservoir Project are tabled below:

Table 2-3: Kangsabati Reservoir Project

Sl. No	Description	Remarks
1	Location	Mukutmanipur, District Bankura on the rivers Kangsabati and Kumari about 3.2 km. upstream of their confluence.
2	Catchment Area	3625 sq. km (1400 sq. Miles)
3	Design Discharge	5663.32 cumec (2,00,000 cusecs)
4	Canal & Barrage Discharge	Left - 192.55 cumecs (6,800 cusecs) Right - 70.75 cumecs (2,500 cusecs)
5	Pickup Barrages	i) Silabati, ii) Bhairabanki, iii) Tarafeni

2.2.5.2 Barrage and Irrigation System of Damodar Valley Corporation (DVC)

The river Damodar has a basin area of 58,480 sq. km. of which 32,110 sq. km. is in Jharkhand (erstwhile Bihar). A comprehensive programme of flood control, irrigation and power generation was planned under a corporation with participation of Bihar, West Bengal and Govt. of India. DVC was formed in 1948. Four dams situated in Jharkhand is complete though acquisition of some flood storage areas still remains incomplete. The irrigation and canal system of DVC has been handed over to the Govt. of West Bengal in 1964.

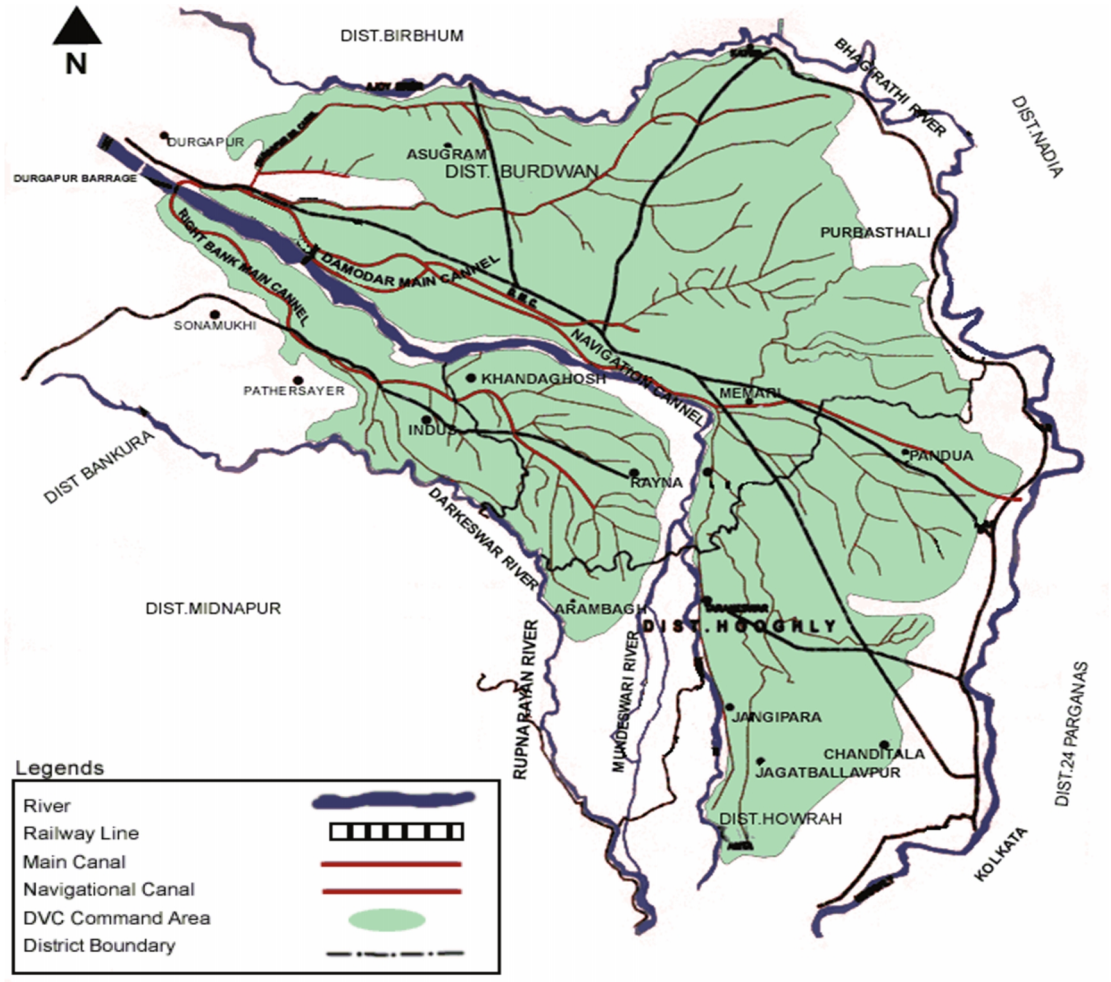


Figure 9: Barrage and Irrigation System of DVC

In the original project, the DVC canal system was designed mainly to provide irrigation in Kharif and Rabi period. Now, the system has started providing irrigation to summer paddy also. At present further work for increasing irrigation coverage by reducing transmission losses and changing cropping pattern has been taken up.
An irrigation potential of 4,83,500 hectare out of its ultimate irrigation potential of 5,10,110 hectare has been created through the project in the districts of Burdwan, Bankura, Hooghly and Howrah.

Table 2-4: Barrage and Irrigation System of DVC

Sl. No	Description	Remarks
1	Location	Durgapur, District Burdwan on the river – Damodar
2	Catchment Area	19.547 sq. km. (7,635 sq. Mile) Damodar – Barakar Basin
3	Design Discharge	15,574 cumecs (5,50,000 cusecs)
4	Canal Discharge	Left - 259 cumecs (9,146 cusecs) Right - 64 cumecs (2,260 cusecs)

2.2.5.3 Irrigation Dams and Canals

Kadam-Deuli Dam-Silabati

The Kadam-Deuli dam is located on the Silabati river. It is also known as Silabati Barrage. The Dam is linked to the Kangsabati dam through the Khatra Main Canal.

Figure 10: Kadam-Deuli Dam on Silabati

Some of the other notable dams and canals include:

- Berai Canal, on Dwarkeshwar
- Sali reservoir
- Suvankar dangra on Dwarkeshwar

But all these dams and canals are primarily for Irrigation purposes, although the Gangdua dam (In Gangajalghati) has been used for Supply of potable water.

2.3 Geomorphology and Hydro-geology

2.3.1 Geomorphology

There are three distinct geomorphic units with characteristic morphological assemblages, these are:

(a) **The hilly terrain in the West:** It is covered by crystalline rocks of Archean age, characterized by hillocks, low ridges and valleys. Susunia Hills (493m) and Biharinath Hillas (447.8m) are the highest surface elevation of the unit. There are other small hills like Mejhia Karo around Gangajalghati block and in other blocks e.g. Khatra, Ranibundh, Raipur. The average elevation of these hills ranges between 100 – 150m above mean sea level. The entire geomorphic unit is the continuation of Chotonagpur plateau.

(b) **The Eastern Plain land:** The eastern part of the district comprising the blocks of Bishnupur, Kotulpur, Indus etc. is flat land which promotes intense cultivation. The surface elevation of this unit ranges between 10-50m above mean sea level with gentle slope. At places the flat land shows dissected type of topography and is devoid of natural swamps or lakes.

(c) **The marginal undulating tract**: This is relevant in the central part of the district where hilly terrain of the western part slowly merges into plain alluvial land. This geomorphic unit is favourable for the growth of forest area in the district. The morphology of this unit presented highly dissected topography where the average surface elevation is of the order of 100m above mean sea level.

2.3.2 Geology

The geology of Bankura is characterized broadly in four lithounits as under:

1. Crystalline granite gneisse of Archaean age is exposed in the Western part of the District covering Blocks of Chhatna, Bankura-I & II, Indpur, Khatra, Hirbundh, Gangajalghati, Ranibundh, Sarnga and parts of Saltora and Mejia.
2. Sedimentary Sandstone and Shale of lower Gondwana age occupy the northern and north-western parts of the district as small patches, covering parts of Saltora and Mejhia blocks.
3. Quaternary alluvium occupy the eastern and south-eastern parts of the district covering Bishnupur, Sonamukhi, Kotulpur, Indus, Joypur and Patrasayer Blocks.
4. The marginal tract covering Simlapal, Taldangra, Onda & parts of Barjora and Bishnupur blocks covered by laterites and quaternary alluvium underlain by basement rock at shallow depth within 40m.

2.3.3 Hydro-geology and Ground water potential

The diverse geological set up of Bankura district control the hydro-geological condition of the district. According to Central Ground Water Board (CGWB), in areas underlain by hard crystalline and Gondwana rocks and groundwater occurs under:

(1) Unconfined condition in the weathered residuum down to the depth of about 15m bgl, with maximum upto 25 m bgl; and

(2) Under semi-confined to confined condition in the fractured zones in the depth span of 30-60m bgl. Resistivity survey shows that in some places a deeper fracture zone is also expected to occur at a depth span of 80-100 m bgl.

Groundwater in the un-confined condition is generally developed through open wells in the weathered zone and the available discharge can only meet the domestic need, but not sufficient for any large scale development of groundwater.Groundwater from the zone of secondary porosities is developed through bore wells yielding 45-150 lpm.

A map showing the hydro-geological disposition in Bankura is show below:

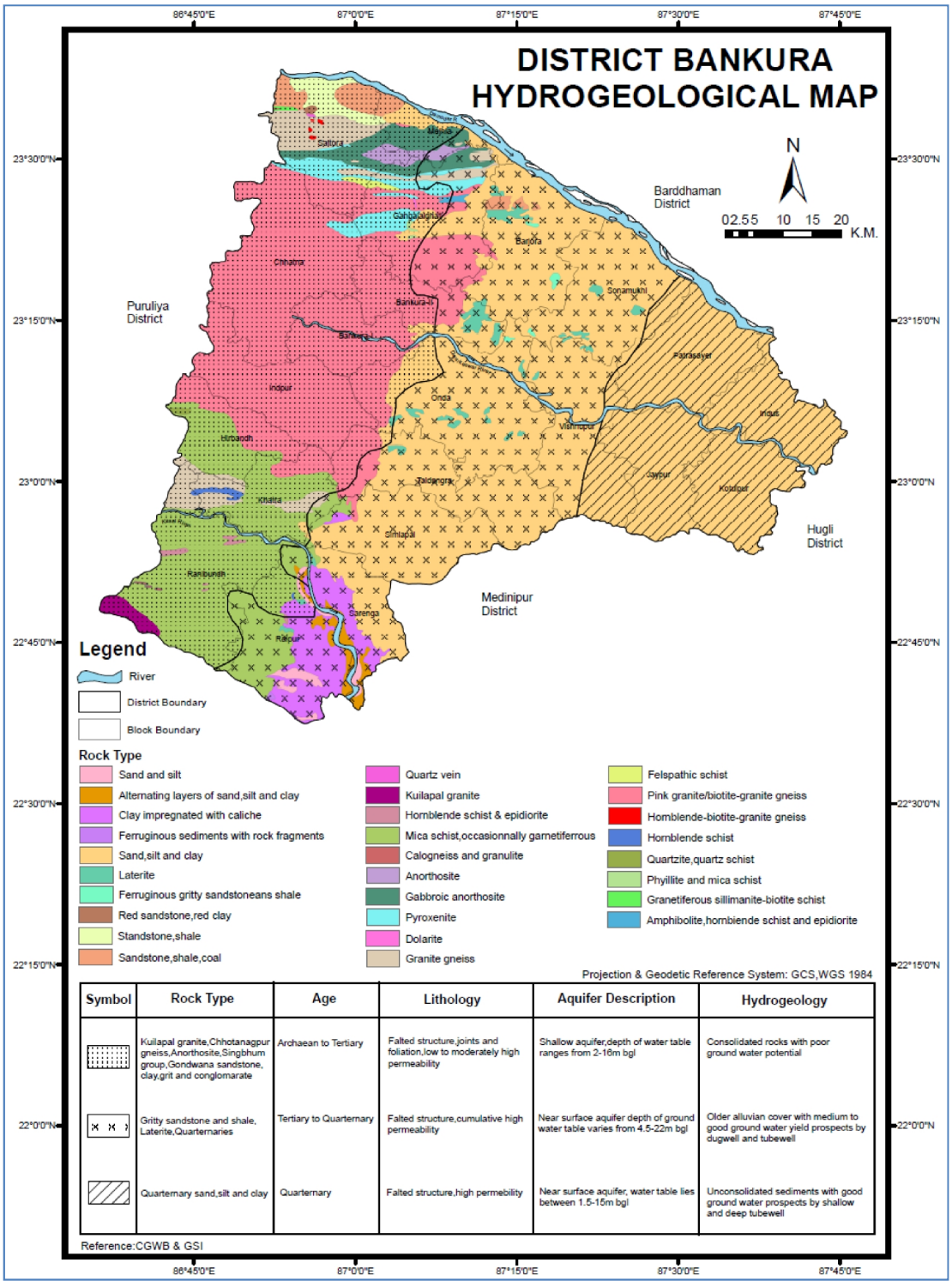


Figure 11: Hydro-geological Map of Bankura

About two third of the district is covered by alluvium, older alluvium and laterites occur in central–southern part of the district. Groundwater exploration carried out in the area indicates that the thickness of the alluvial sediments increases eastward from 36m in the marginal part to 150m in the eastern most part. Potential aquifers exist between 30 and 95m bgl and the discharge of the wells tapping such aquifers varies from 20 to 124 m3/hr with drawdown ranging from 6 to13m. Depth to water level in the older alluvium varies from 6 to15m bgl during pre-monsoon period.

The dug-wells in the laterites usually dry up in summer, but those wells which have penetrated through the laterites to underlying lithomarge are found to contain water during the summer months also.

A detailed study on Groundwater Resources Assessment and Management of the Bankura District, West Bengal was carried out by Center for Study of Man and Environment (CSME, 1990-1993) under Department of Science and Technology (GoI) sponsored project revealed that:

- Groundwater occurs under unconfined condition in the hard rock areas of the district and the potential aquifers comprise two units viz. a weathered residuum which is 10 to 20 m thick and the underlying fractured hard rock upto a depth of at least 50 m.
- In the laterite and older alluvium, occupying about 30 percent area of the district in Onda, Taldangra, Simlapal, Raipur, parts of Bankura, Bishnupur, Sonamukhi block, groundwater occurs under unconfined condition.

In the eastern alluvial areas covering Indus, Kotulpur, Joypur, Patrasayer and parts of Taldangra, Bishnupur and Sonamukhi blocks, groundwater occurs both under unconfined condition in the shallow aquifers and under confined condition in deeper aquifers occurring below a blanket of clay of thickness varying between 9 and 35 m.bgl.

There is a vast scope for increasing groundwater recharge in the district by construction of various water harvesting structures such as percolating tanks, sub-surface dykes, gully plugging etc. to store the excess run off. These structures would not only help in recharging the groundwater but also reduce soil erosion and increase soil moisture content (CSME,1993).

Large diameter dug-well pump test in the western hard rock area revealed that the aquifer was of low potentiality with the permeability and transmissivity varying from 0.1 to 22.18 m/day and 7.40 to 34.08 m^3/day respectively. The average inflow rate of groundwater into the wells varied between 4.63 and 43.20 m^3/day. In the eastern alluvial areas heavy duty tube-wells for irrigation were installed within the depth range varying from 87-304 m.bgl and with discharge varying between 94-183 m3/hr.

The dynamic groundwater resource of Bankura district estimated jointly by CGWB & SWID following the Ground Water Estimation Committee (GEC 1997) methodology (As on 31.03.2004) is as presented below:

Table 2-5: Dynamic Ground Water Resources

Sl. No	Description	Data
1	Total Groundwater Resources	209153 ham
2	Net annual groundwater availability	189926 ham
3	Existing groundwater draft for all uses	56837 ham
4	Stage of Groundwater development	30%
5	Allocation for domestic and industrial water supply requirement upto 25 years	6376 ham
6	Net groundwater availability for future irrigation development	131453 ham
7	Categorisation of blocks	All the blocks are in the SAFE category

A pictorial representation of the available ground water resources for the blocks within Bankura is shown below:

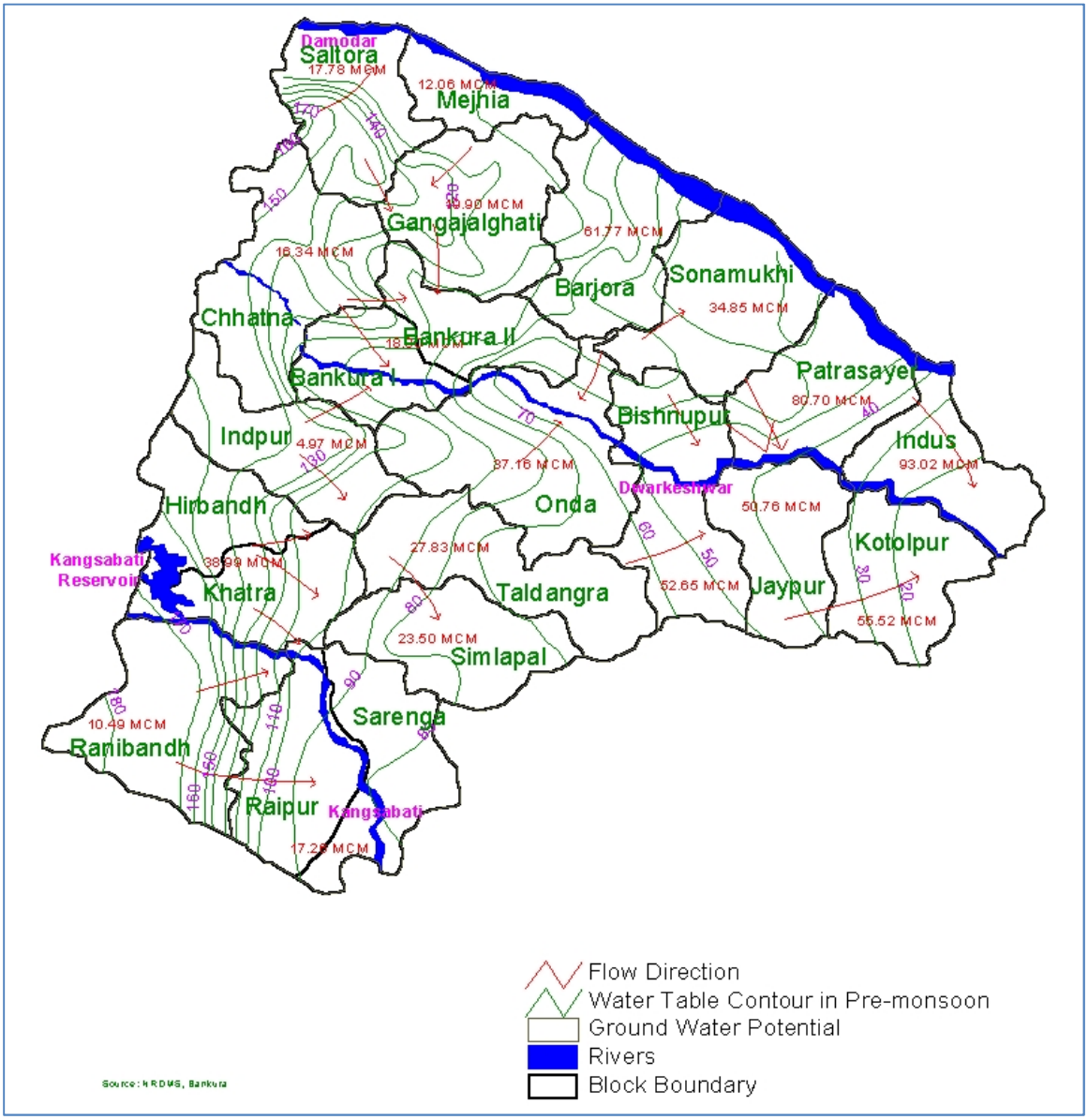


Figure 12: Dynamic Ground Water Resources

The ground water potential of each block as per the Central Ground Water Board brochure is summed up in Annexure-06.

2.4 Water Quality Status

According to CGWB the high concentration of fluoride and iron in groundwater is a serious problem in the district. Groundwater in 10 blocks namely Taldangra, Simlapal, Raipur, Indpur, Bankura II, Saltora, Barjora, Hirabundh, Chhatna and Gangajalghati is affected sporadically by high concentration of fluoride in groundwater i.e more than the permissible limit (>1.5 mg/l). This occurs in different hydro-geological formations namely:

- In fractured granite within 40 to 50 m
- In older alluvium sediments 40 to 50 m.

In Bankura district quite high concentration of iron in ground-water has been found (up to 9.5mg/l). Though iron content in drinking water may not affect the human

system as a simple dietary overload, but in the long run prolonged accumulation of iron in the body may result in homo-chromatosis, a disease in which tissues are damaged. It is generally recognized that concentrations above 0.3mg/l in household water can lead to staining of clothes during washing.

Groundwater in the upper reaches of the district and flanks is of Calcium bicarbonate, while in the lower reaches the groundwater of Calcium Chloride type with relatively higher TDS (CSME, 1993).

2.4.1 Blocks Affected by Fluoride Contamination

As per the Water Quality Monitoring System, out of the 22 Blocks a total of 17 Blocks have been identified which have had recurrence of Fluoride contamination. Pictorial representation of the Fluoride affected Blocks in Bankura as mapped based on the Water Quality Monitoring and Surveillances system is presented below:

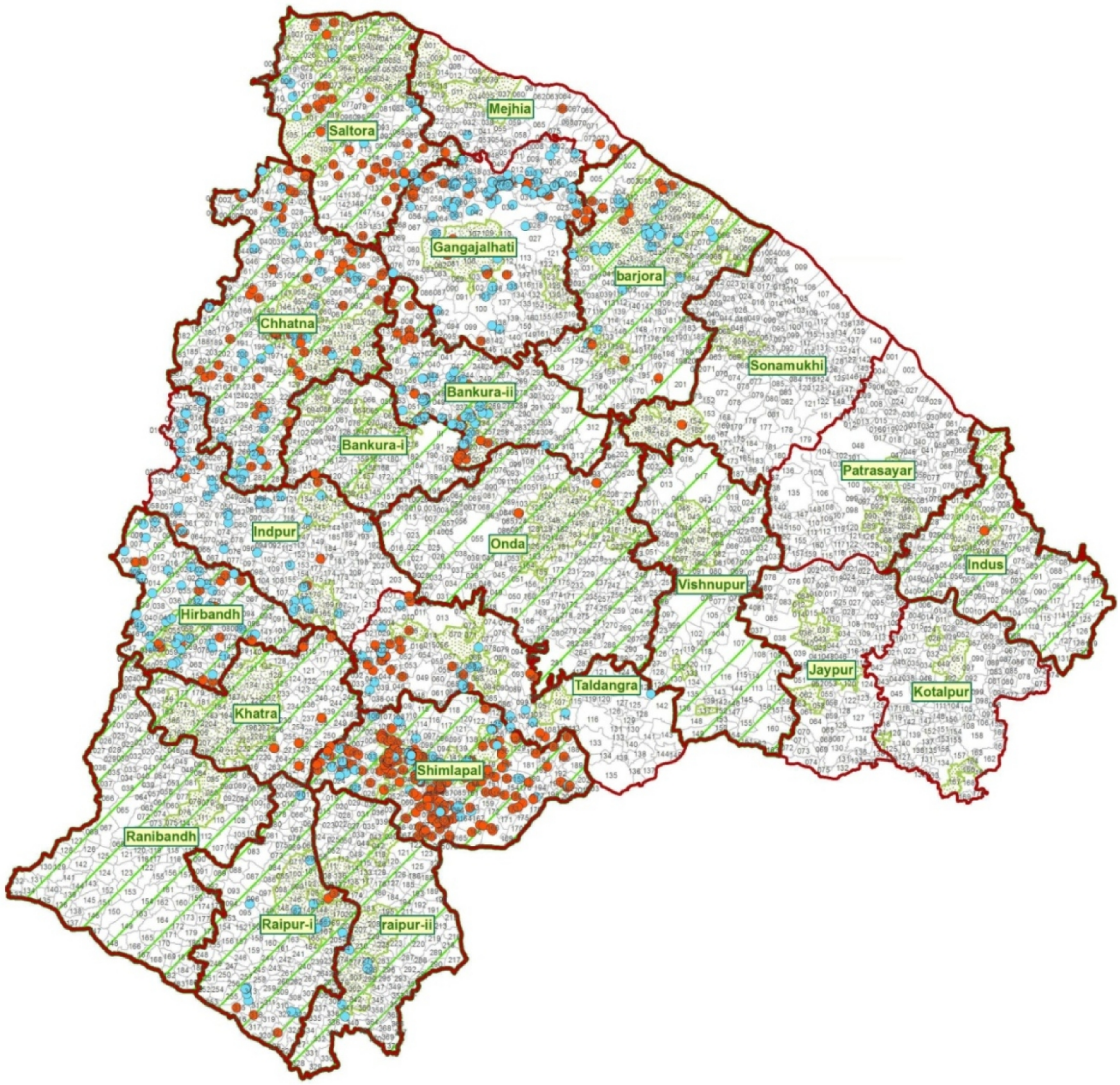


Figure 13: Blocks affected by Fluoride Contamination in Bankura

The light blue dots denote Fluoride Contamination between 1.0 – 1.5 Mg/l, whereas the Brown dots denote Fluoride Contamination beyond 1.5 Mg/L.

2.4.2 Sources of Fluoride

The presence of fluoride in groundwater can be attributed to geological reasons. (A.K.Yadav et al.2009). Fluoride exists naturally in water sources. Generally most

groundwater sources have higher fluoride concentrations than surface water. The main source of fluoride in groundwater is basically from the rock minerals. The high concentrations in groundwater are a result of dissolution of fluorite, apatite and topaz from the local bedrock, and the general negative correlation between fluoride and calcium concentrations ingroundwater.

The geology, chemical weathering and composition of bed rocks/soils/sediments play a major role in fluoride contamination of ground water. The Geological Survey of India has also observed that the Precambrian terrain with fractured/shear zones are possible locale for fluoride contamination in ground water in parts of [16]Purulia and Bankura Districts.

2.4.3 Assessment of affected habitations

2.4.3.1 Based on [17]IMIS Data

Habitation wise water quality data available from the National Rural Drinking Water Program (NRDWP) site were compiled to get an overview of status of water quality situation with special emphasis on Fluoride concentration. Details of Fluoride Contamination as reported in the various blocks in 2013-14, 2014-15, 2015-16 and 2016-17 is presented in Annexure-07. The data compiled for last four years (2013-17)is summarized and tabulated below:

Table 2-6: Compiled Summary of Fluoride Contamination in Bankura (2013-17)

Sl. No.	Name of Blocks	Number of Samples Tested	Fluoride Concentration				Affected Habitation with Fluoride Concentration	
			> 1.5(mg/l)		1.0 - 1.5(mg/l)		> 1.5(mg/l)	1.0 - 1.5(mg/l)
			Nos	%	Nos	%		
1	Bankura I	1854	2	0.11%	29	1.56%	2	18
2	Bankura II	2657	25	0.94%	95	3.58%	19	53
3	Barjora	2751	18	0.65%	35	1.27%	13	20
4	Bishnupur	2368	0	0.00%	3	0.13%	0	3
5	Chhatna	5250	67	1.28%	198	3.77%	47	137
6	Ganjagalghati	5007	26	0.52%	259	5.17%	20	107
7	Hirabandh	1684	10	0.59%	53	3.15%	10	41
8	Indpur	2651	7	0.26%	36	1.36%	7	27
9	Indus	2077	2	0.10%	2	0.10%	2	2
10	Jaypur	2054	0	0.00%	0	0.00%	0	0
11	Khatra	1842	6	0.33%	4	0.22%	5	4
12	Kotulpur	1737	0	0.00%	2	0.12%	0	2
13	Mejia	867	4	0.46%	61	7.04%	4	23
14	Onda	3378	1	0.03%	1	0.03%	1	1
15	Patrasayer	1704	0	0.00%	0	0.00%	0	0
16	Raipur	2462	11	0.45%	29	1.18%	5	22
17	Ranibundh	2104	0	0.00%	6	0.29%	0	5
18	Saltora	1969	43	2.18%	131	6.65%	31	59
19	Sarenga	1425	2	0.14%	0	0.00%	2	0
20	Simlipal	2149	167	7.77%	68	3.16%	95	57
21	Sonamukhi	1704	1	0.06%	0	0.00%	1	0
22	Taldangra	3140	21	0.67%	33	1.05%	12	19
TOTAL		52834	413	0.78%	1046	1.98%	276	600

[16]District adjoining of Bankura in West Bengal
[17]Integrated Management Information System as maintained by Ministry of Drinking Water and Sanitation

Summing up the last four years data, as compiled, it has been observed that out of 52834 water samples tested across the 22 blocks, Fluoride concentration above 1.5mg/l was observed in 413 samples. Total 275 habitations are affected by high Fluoride contamination. These samples were tested mainly from tube-wells. Also an estimated 1046 (1.98%) samples showed fluoride concentration between 1.0 and 1.5 mg/l.

Based on the analysis, high fluoride is noted in 10 blocks namely Bankura II, Barjora, Chhatna, Ganjagalghati, Hirabandh, Mejia, Raipur, Saltora, Simlipal and Taldangra and is considered as [18]severely affected. The blocks, which are moderately affected, are Bankura-I, Indpur, Indus, Khatra, Onda, Sarenga and Sonamukhi. The 5 blocks which are unaffected with Fluoride contamination are Bishnupur, Joypur, Kotulpur, Patrasayer and Ranibandh.

Apart from Fluoride, about 68% of the groundwater samples show Iron-concentration above the permissible drinking water standard (0.3mg/l). E-Coli and Coliform were also present above the permissible limit in samples tested.Details of other quality parameters based on IMIS data (from 2013-2017) is tabled below:

Table 2-7:Summary of Water Quality Parameters

Year	Samples Tested	**Samples with**			
		Coliform >[0MPN/100ml]	E-Coli > [0MPN/100ml]	Fe > 0.3 (mg/l)	Hardness >200 (mg/l)
2013-14	14536	6927	1739	6984	895
	Range	1 –60 MPN/100 ml	0.06 –90 MPN/100 ml	0.31 – 8.70mg/l	602 – 5001mg/l
2014-15	26807	6236	2010	20091	2451
	Range	0.6 –9.0 MPN/100 ml	0.2 –90 MPN/100 ml	0.31 – 9.64mg/l	604 – 4700mg/l
2015-16	9383	4876	962	7374	617
	Range	1.0 –9.0 MPN/100 ml	0.02 –110 MPN/100 ml	0.31 – 9.68mg/l	604 – 1844mg/l
2016-17	2114	722	4	1557	65
	Range	4 –1600 MPN/100 ml	2 –17 MPN/100 ml	0.31 – 8.65mg/l	68 – 12365mg/l
Total	52840	18761	4715	36006	4028
% of Samples tested positive		35.5%	8.92%	68.1%	7.6%

[18]The rationale for severely affected blocks has been assessed based on the consideration that the % of Samples tested with Fluoride Content > 1.5mg/litre is more than 0.4%

2.4.3.2 Based on Updated PHED Data

An independent analysis carried out with (Updated) data sourced from PHED, indicated that 296 habitations were affected in 17 blocks of Bankura district.

The Concentration of Fluoride in all these blocks were higher than permissible limit of 1.5 mg/l. Simlipal block is the worst affected with 100 nos. of affected habitations and fluoride concentration as high as 9.86 mg/l being reported. Summary of the data results as available is presented below:

Table 2-8:Summary of Fluoride Concentration in Bankura (PHED Data)

Sl. No.	Name of Blocks	Habitation affected by F Conc. > 1.5mg/l	Minimum F Conc. (mg/l)	Maximum F Conc. (mg/l)	Mean F Conc. (mg/l)
1	Bankura I	5	1.62	4.15	2.30
2	Bankura II	27	1.50	5.10	2.58
3	Barjora	12	1.52	6.22	2.47
4	Chhatna	52	1.50	8.12	2.30
5	Ganjagalghati	19	1.51	2.75	1.91
6	Hirabandh	10	1.54	10.8	3.47
7	Indpur	7	1.52	7.09	3.53
8	Indus	1	-	1.59	1.59
9	Khatra	8	1.66	6.95	3.17
10	Mejia	4	1.50	3.22	2.05
11	Onda	2	2.46	6.75	4.60
12	Raipur	6	1.5	4.67	2.53
13	Saltora	28	1.5	3.97	2.28
14	Sarenga	2	2.01	6.66	2.02
15	Simlipal	100	1.5	9.86	1.81
16	Sonamukhi	1	-	9.00	9.0
17	Taldangra	12	1.57	9.80	2.82
Total		**296**			

Ground Water data as collated is presented in Annexure-08.

2.5 Impact of Climate Change

Climate change, as studies suggest, may alter the distribution and quality of natural resources, enhance water insecurity, reduce agriculture productivity, enhance exposure to extreme weather events, and pose even unforeseen health risks.The observed effects of climate change on water services relate to:

- Reduction of Water availability in the basins
- Reduction in dissolved oxygen content, mixing patterns and self-purification capacity. Increase in algal bloom.
- Intrusion of Salinity in coastal aquifers
- Changes in water availability due to changes in precipitation and other related phenomena (evapo-transpiration, ground-water recharge).
- Increases the difficulty of flood control and reservoir utilisation during flooding season.
- Floods affecting water quality and water infrastructure integrity, increased fluvial erosion, draught affecting water availability and water quality

2.5.1 Impact of Climate Change on Water Availability

An estimate of water availability in the critically affected districts of West Bengal and per capita water availability, in terms of average monsoon and non-monsoon rainfall, available surface water availability, groundwater availability and flow of trans-boundary water into the state, as provided in the State Action Plan on Climate Change (SAPCC) is tabled below for reference.

Table 2-9: Assessed Impact of Climate Change on Water Resources

District	Rainfall (mm)		Surface water (BCM)	Ground water (BCM)	Trans-boundary water	Per Capita water as of 2001 CM/Capita
	Monsoon	Non-monsoon				
Bankura	1159.7	387.5	2.06	2.09	13.35	1309.8
North 24 Paragans	1231.0	452.3	1.91	1.58	50.33	393.6
Purba Mednipur	1240.3	457.6	3.27	0.83	76.68	820.5
Murshidabad	1167.4	385.6	0.54	2.52	561.88	525.63
Haorah	1240.5	451.2	0.96	0.37	67.36	313.6
Hoghly	1208.2	441.4	0.59	1.70	65.28	457.6

The SAPCC categorized the districts into 4 divisions, Severe Scarcity: < 500Cum / Capita, Water Scarcity: 500 – 1000 Cum/Capita, Water Stressed: 1000 – 1600 Cum/Capita and Water Sufficient: > 1600 Cum/Capita.

2.5.2 Impact of Climate Change on Water Quality

Climate-related warming of rivers has been observed over recent decades, with implications for changes in water salinity, water nutrient content, concentration of pesticides and other pollutants, salinization of groundwater, water chemistry and pH balance. The deterioration of surface water sources is already a matter of concern.

The WB Pollution Control Board is monitoring the water quality of rivers, such as Hooghly, Damodar, Barakar and Rupnarayan by analysing the physico-chemical, bacteriological and biological parameters. The PHED is conducting regular water quality tests to identify the extent of contaminants. However, comprehensive data and studies need to be conducted to assess the water quality for surface and ground water sources.

2.6 Socio-Economic Status (Including Gender and Health)

2.6.1 Demographic Profile

The total population in rural and urban community development (CD) blocks in Bankura district is 3.36 million, belonging to 0.72 million households. The average household size in the district is 4.7, and the sex ratio for the overall population of the CD blocks in the district is 956 females per 1000 males. Sex ratio in the 0-6 age group is lower, at 948 females per 1000 males and that for scheduled tribes, significantly higher at 1010, than for scheduled castes at 977 females per 1000 males. About 33.4% of the population in the CD blocks of the district comprises scheduled castes, while scheduled tribes comprise 10.9% of the total population. Bankura features in the list of districts with a higher concentration of scheduled tribes in the state.[19]

2.6.2 Economic Profile

Workforce participation in Bankura is high at 41% in the district (Census 2011). As per published data of Government of West Bengal, in 2012-13, the Gross District Domestic Product (GDDP) of Bankura district was Rs. 11095.06 crores. The district's contribution to the state domestic product of West Bengal is estimated at 3.21%. The district per capita income of Rs. 26996 is significantly lower than the state average of Rs. 33,889.

2.6.3 Health and Gender

Available health and gender indicators from District Level Household and Facility Survey-4 (DLHS-4) indicate the level of development of the district. The proportion of institutional births in rural areas of the district is 84.5%, close to the overall district average of 85.6%. Percentage of children who received full vaccination is high at 96.2% and 95.9% in the overall district and in its rural areas, respectively. Prevalence of diarrhoea among under-five age group children is reportedly 5.1% in the overall district and 5.2% in its rural areas. The proportion of women who were married at below18 years of age is higher in rural areas (40.3%) than in the overall district (38.3%).

[19]There are no scheduled areas as defined by the Indian Constitution in the state of West Bengal. Tribal communities are present in all the districts of the State, with higher concentration of tribal population n districts like Darjeeling, Jalpaiguri, Alipurduar, Dakshin Dinajpur, Paschim Medinipur, Bankura and Purulia.

Chapter 3 Present Coverage of Water Supply

3.1 Commissioned Piped Water Supply Schemes

A review of the Existing WS Schemes based on piped water supply that have been commissioned as well as ongoing is dealt to assess the Blocks that are presently uncovered with piped water supply. The WS Schemes that have been commissioned have been categorized based on:

(1) Ground Water Sources

(2) Surface / Sub-surface based sources and

(3) Other Sources (Rain water Harvesting etc)

The WS Schemes that are ongoing have been taken up later. Special mention must be made for the Piped Water Supply Scheme funded under Backward Regional Grant Fund, which is in progress for select 14 Blocks of Bankura, for it magnitude and coverage.

3.1.1 Commissioned Schemes Based on Ground Water

A total of 43 WS Schemes based on Ground water schemes have been commissioned by the PHED (As listed in the website) in 20 Blocks (The Blocks of Hirbandh and Ranibandh did not have any WS Scheme based on Ground water). The total number of habitations covered is 606. For ease of understanding, the Schemes have been re-framed corresponding to each block. The details of the Schemes, with respect to habitation level coverage and year of completion is summed up in Annexure-09(Table-1).

3.1.2 Commissioned Schemes Based on Surface / Sub-Surface Sources

A total of 10 Water Supply Schemes have been commissioned, of which 8 Schemes are based on Sub-surface water and 2 Schemes have been drawn up from Surface sources. A total of 191 habitations have been covered for Schemes based on sub-surface water, whereas 242 habitations have been covered under the 2 surface-water based Schemes. The details of the Water Supply Schemes and the source along with the habitation coverage are tabled In Annexure-09 (Table-2).

3.1.3 Piped Water Supply from Other Sources

Piped Water Supply within selected Blocks has also been provided through rain water harvesting and dual use solar pumps (Drawing ground water).

The dual use solar pumps were used to draw water from shallow tube-wells and convey to local communities. The Scheme was drawn up for select habitations of Bishnupur and Taldangra in Bankura. The details of these Water Supply Schemes, their sources and habitation coverage are also given in Annexure-9 (Table-3).

3.2 On-going Water Supply Schemes

A total of sevenwater supply schemes are presently ongoing in Bankura, of which five are based on sub-surface sources, and oneis dependent on ground water. A total of 48 habitations were covered. Details of the ongoing water supply schemes are presented in Annexure-9 (Table-4).

3.3 Comprehensive PipedWSProject for selected 14 Blocks

In the 11thFive Year Plan[20], priorities were given for sustainable water supply schemes to all sections of the rural habitation. In line with the national objectives, Government of West Bengal (GoWB) decided to consistently ensure the availability of safe and acceptable drinking water supply in sufficient quantity to the water distressed districts of Bankura, Purulia and Paschim Medinipur, considering relatively low piped water supply coverage, and in the backdrop of social backwardness and higher tribal population etc.

Initially all 22 blocks were proposed to be covered, however, GoWB decided to cover 14 (Fourteen) Blocks in first phase. The first phase was sanctioned in 2011 for Rs 1011.22 Crores with Backward Region Grant Fund of GoI. The Piped Water Supply Scheme under BRGF emphasized on surface / sub-surface water source to ensure sustainability and was prepared considering comprehensive coverage of all the habitations within the selected 14 Blocks.

Salient features of the Project are presented below:

1. Per Capita Supply was considered as 70 lpcd for both rural areas and urban. The project covered 14 blocks and 2 municipalities (Bankura and Bishnupur).
2. The design year for the project was taken as 2036. The total water abstraction under the project is 248.4 Mld, of which 26.6 Mld is for the Municipalities, and the rest is for the rural areas.
3. The project had a total of 46 WS Schemes and 132 WS Zones.A total of 21 WS Schemes were based on ground water. 23 were based on Sub-surface abstraction and 2 Schemes were based on Surface water. Onda block had the maximum bumber of WS Schemes-13, of which 10 were based on ground water.
4. The project had 3 Integrated WS Schemes, namely:
   (a) Comprehensive piped WS Scheme for blocks of Bankura-I, Bankura-II and Barjora, (including Bankura Municipality) with water sourced from Durgapur barrage with Water Treatment Plant of Capacity 74 Mld.
   (b) Comprehensive piped WS Scheme for blocks of Hirbandh, Khatra and Ranibandh with water sourced from Kangsabati dam and Water Treatment Plant of Capacity 27 Mld and
   (c) Comprehensive piped WS Scheme for blocks of Saltora and Chhatna, by abstraction of Sub-surface water from Damodar, through Construction of Infiltration Gallery of 41 Mld.

The number of WS Schemes that has been drawn out against each block is tabled below:

Table 3-1: Water Sources tapped under BRGF

Sl. No	Name of Block	Nos. of Schemes	Potential Source Considered			Surface / Sub-Surface Source tapped
			Surface	Sub-Surface	Ground	
1	Bankura-I	1	1	-	-	Durgapur barrage
2	Bankura-II					
3	Borjora					
4	Chhatna	1	-	1	-	Damodar River
5	Saltora					

[20]Since 1947, the Indian economy has been premised on the concept of Five-Year Plans, developed, executed, and monitored by the Planning Commission (NITI Aayog after 2014).The period of 11th Five year Plan was from 2007-12.

Sl. No	Name of Block	Nos. of Schemes	Potential Source Considered			Surface / Sub-Surface Source tapped
			Surface	Sub-Surface	Ground	
6	Hirbandh	4	1	3	-	Kangsabati dam and Sub-surface of Kangsabati
7	Khatra					
8	Ranibandh					
9	Bishnupur	7	-	4	3	Dwarakeswar River
10	Indus	8	-	4	4	Damodar River
11	Onda	13	-	3	10	Dwarakeswar River
12	Simlapal	4	-	3	1	Silabati
13	Sarenga	3	-	2	1	Kangsabati
14	Raipur	5	-	3	2	Kangsabati
Total		46	2	23	21	

Based on the project proposals, the disposition of water sources that are to be abstracted are presented below:

Table 3-2: Summary of the Water Abstraction from various Sources under BRGF

Sl. No	Block	Census 2011	Design Population (2036)	Raw Water Demand (In Mld)	Water Abstraction (In Mld) met		
					Surface Source	Sub-Surface	Ground Water
1	Bankura-I	95840	162932	13.34	55.3		
2	Bankura-II	123415	209811	17.18			
3	Borjora	179007	302994	24.81			
4	Chhatna	169215	284848	23.33		40.3	
5	Saltora	121552	206644	16.92			
6	Hirbandh	72502	123258	10.1	30.4		
7	Khatra	102569	88950	7.29			
8	Ranibandh	104326	159165	13.04			
9	Bishnupur	138768	187381	15.33		8.1	7.2
10	Indus	152847	235795	19.31		8.8	10.5
11	Onda	220572	297890	24.40		14.4	10.1
12	Simalapal	127445	160456	13.14		5.1	8.1
13	Sarenga	95128	110949	9.09		6.7	2.4
14	Raipur	151293	177324	14.53		8.5	6.0
Total Rural		1854479	2708397	221.81	85.8	91.8	44.3
	Municipality						
1	Bankura	128781	209012	17.94	17.9		
2	Bishnupur	61947	100540	8.62		8.6	
Total Urban		190728	309552	26.6	17.9	8.6	0.0
Gross Total		**2045207**	**3017949**	**248.4**	**103.7**	**100.4**	**44.3**

3.4 Water Supply Coverage in Urban Areas

As per notification of the Government of India, the Department of Municipal Affairs, Government of West Bengal initiated efforts to collect database for basic service sectors, viz. Water Supply, Sewerage, Solid Waste Management and Drainage to assess the existing status of the urban local bodies.

Based on the Notification, a comprehensive data collection process was carried out under the aegis of the Department of the Municipal Affairs. For the district of Bankura, the data was compiled for the town of Bankura, and details of the other 2 Municipalities, namely Bishnupur and Sonamakhi were unavailable. The prevailing status of the service level benchmark standard would provide an assessment of the water quality standards within the urban confines.

Table 3-3: Service Level Benchmark Standards-Bankura

Sl. No	Description of Indicators	Benchmark Standard	Present Status	[21]Reliability Category
1	Coverage of water supply connections	100%	50%	D
2	Per capita supply of water	135 Lpcd	15 Lpcd	D
3	Extent of metering of water connections	100%	0%	A
4	Extent of non-revenue water (NRW)	20%	80%	D
5	Continuity of water supply	24 Hrs	3 Hrs	B
6	Quality of water supplied	80%	30%	C
7	Efficiency in redressal of customer complaints	100%	100%	C
8	Cost recovery in water supply services	100%	30%	C
9	Efficiency in collection of water supply-related charges	90%	0%	D

It may be noted that planning for Bulk Water Supply for the urban Municipalities in Bankura (Bankura, Bishnupur and Sonamukhi) has been taken up by PHED, since, most of the sustainable water sources were far off and also the Urban Municipalities did of have the economic means to implement large scale projects.

3.5 Assessment of Existing Schemes

The Water Supply Scheme under BRGF for the select 14 Blocks of Bankura (namely Barjora, Bankura-I, Bankura-II, Bishnupur, Chhatna, Indus, Onda, Raipur, Saltora, Sarenga, Simlapal, Hirbandh, Ranibandh and Khatra) is ongoing. An assessment of the Existing WS Schemes under the same as such would be more significant, once the project has completed in entirety. Also, in all likelihood, developing / planning for new WS Schemes in the 14 blocks is not desirable considering the existing project under BRGF is yet to be completed.

In Contrast, it would be more prudent to look at the coverage of the prevailing Water Supply system in the (8) blocks which have not yet been covered under BRGF project.

3.5.1 Water Supply Coverage of Blocks- Not Covered under BRGF

Based on the available database of PHED, a comprehensive WS Coverage in the 8 Blocks not covered under the ongoing BRGF, has been drawn up.

Table 3-4: Status of WS Coverage in Blocks- Not Under BRGF

Sl. No	Name of Block	Total Habitations	Habitation Covered		Habitations with population Coverage	
			Partially (<40 Lpcd)	Fully (>40 Lpcd)	0% - 25%	25% - 50%
1	Mejhia	118	70	34	25	28
2	Gangajalghati	239	111	84	38	23
3	Indpur	283	148	132	28	18
4	Taldangra	356	98	250	30	5
5	Sonamukhi	455	226	192	79	27
6	Patrasayer	368	145	200	41	38
7	Joypur	229	26	169	8	0
8	Kotulpur	350	247	74	83	19
	Total	2398	1071	1135	332	158

It may be clarified that the Habitation / Population coverage relates to all water sources includes dug-wells, hand pumps, piped water supply related to tube wells and surface based sources.

[21]The Category of Reliability of data is as defined in the SLB data handbook of the Ministry of Urban Development. Reliability of "A" is the highest and "D" is the poorest.

3.5.2 Coverage of Piped WS Schemes- Not covered under BRGF

The data relates to coverage of all available water sources (including piped Water Supply System). In stark contrast is the scenario, if only we look at the piped Water Supply system. Based on the list of Commissioned and ongoing WS Schemes, a matrix showing the extent of Habitations covered under piped WS Scheme and their sources is tabled below:

Table 3-5: List of Habitations Covered under Piped WS- Not under BRGF

Sl. No	Name of Block	Total Habitations	Habitations covered under piped WS Scheme, based on			Habitations under piped WS Scheme	% of Total Habitations connected to Piped WS
			Surface Source	Sub-surface Source	Ground Water		
1	[22]Mejhia	118	-	21	7	28	24%
2	Gangajalghati	239	26	-	13	39	16%
3	[23]Indpur	283	-	18	11	29	10%
4	[24]Taldangra	356	-	-	27	27	8%
5	Sonamukhi	455	-	-	84	84	18%
6	Patrasayer	368	-	-	70	70	19%
7	Joypur	229	-	-	23	23	10%
8	Kotulpur	350	-	-	45	45	13%
Total		**2398**	**26**	**39**	**280**	**345**	**14%**

In effect, only 14% of the total rural population in the 8 Blocks is connected with piped Water Supply.

The impact of ground water abstraction and the associated risks (of Fluoride contamination) in the blocks of Mejhia, Gangajalgahti, Indpur and Taldangra and cannot be undermined.

In effect, a comprehensive piped Water Supply Scheme is essential to be drawn up with respect to sustainable water sources to effectively mitigate the risks and impact of Fluoride contamination.

[22]The Sub-surface source is of River Damodar
[23]The Sub-surface source is of River Silabati
[24]Excludes WS Scheme under Dual Use Solar Pump

Chapter 4 Prevailing Sanitation System

Sanitation practices in rural areas involve open defecation, pit latrines and pour flush toilets also. Availability of large tracts of land and ongoing practices of open defecation is still prevalent.

Swachh Bharat Mission (SBM)-Gramin has been initiated by the Government of India and is being implemented by the Ministry of Drinking Water and Sanitation for rural areas with the objective of:

- Bring an improvement in the general quality of life in rural areas by promoting cleanliness, hygiene and eliminating open defecation.
- Accelerate sanitation coverage in rural areas to achieve the vision of Swachh Bharat by 2 October 2019.
- Motivate communities and Panchayati Raj Institutions (PRIs) to adopt sustainable sanitation practices and facilities through creation of awareness and health education.
- Encourage cost effective and appropriate technologies for ecologically safe and sustainable sanitation.
- Develop where required, community managed sanitation systems focusing on scientific solid and liquid waste management systems for overall cleanliness in rural areas

The sanitation practices in rural Bankura are no different from other parts of West Bengal.Under the present Section, we glimpse upon the initiatives of the Government of West Bengal and prevailing toilet coverage to achieve the desired objectives underlaid within the premise of Swachh Bharat Mission (SBM)-Gramin.

4.1 Mission Nirmal Bangla

To accelerate sanitation movement under Swachh Bharat Mission, specifically the rural (Gramin) component, Government of West Bengal has set up a dedicated institution, 'Mission Nirmal Bangla' in the Panchayats & Rural Development Department. “Mission Nirmal Bangla” is aimed at bringing positive changes in the physical quality of life in the villages by promoting cleanliness, hygiene and elimination of open defecation.

The Mission has multi-layered activities intended to reducing the loss of active workdays due to prevalence of diarrheal diseases among the wage seekers; reduce the drop out of children, especially girls due to lack of appropriate toilet facilities in schools; improve overall cleanliness in the villages thereby contributing to improved environmental conditions.

To achieve the larger impacts on the villages and the community, the specific goal of the Mission is to transform all the villages of West Bengal to Open Defecation Free (ODF) villages by 2ndOctober 2019.Developing community managed solid and liquid management systems in the rural areas also features as priorities to improve overall cleanliness and environmental sanitation in the villages.

In effect, the MoDWS has articulated the definition of ODF as “the termination of fecal oral transmission”, which is defined by:

(a) No visible feces found in the environment/village

(b) Every household as well as public/community institutions using safe technology option for disposal of feces. (Safe technology option means no contamination of surface soil, ground water or surface water; excreta inaccessible to flies or animals; no handling of fresh excreta; and freedom from odour and unsightly condition)”

4.2 Pre-Conditions for ODF

Having conditioned that ODF as a step towards cleaner Sanitation practices, we look at the pre-conditions that are essential under the Mission Nimal Bangla and Swachh Bharat guidelines for achieving ODF:

1. All households should have access to sanitary toilets, mostly within the premises and all members of the households should use toilets regularly.
2. All educational institutions (Primary/ Junior/ Secondary/ Higher Secondary Schools/ Madrasahs /other educational institutions/Colleges) should have toilets commensurate with roll strength, separately for the boys and the girls and all students and teachers should use the toilets while in the institution. Appropriate provision for privacy in management of menstrual hygiene and disposal of menstrual waste for the adolescent girl students in schools should be in place.
3. All Anganwadi Centers should have toilet facilities for children to develop hygenic habits among the young ones.
4. Community Sanitary Complexes should be ensured to cater to the need of the homeless and landless people, the commuters and the people spending time at the places of public congregation like markets/ hats/ bus stands.
5. Appropriate arrangements for disposal of solid and liquid waste through household-based, cluster-based and facility-based interventions in vulnerable places.
6. All household in the villages should have access to safe drinking water. People should be aware of safe handling practice of water for drinking and cooking and should regularly practice.
7. Everyone should be aware about washing hands with soap after defecation and handling child's excreta, before preparing food, taking food, feeding children and practice hand washing at critical times.
8. The general cleanliness in the villages should be visible
9. Panchayati Raj Institutions at every stage should propagate sustainable sanitation through effective IEC/ BCC and community mobilization activities.
10. Ecologically safe and sustainable, locally suitable, cost-effective technology for sanitation should be promoted.

The entire process of ODF, involves an internal system of verification with participatory involvement of all households in the community, based on which the village declares itself ODF. The ODF verification occurs in 3 levels, the Village (Gram Sansad), Gram Panchayet and Block level, with respect to specific checklists to be adhered to for at the household level and village level.

4.3 Toilet Coverage and Sanitation Scenario in Bankura

Based on the initiatives, the present status of the outcome of the interventions in Bankura across various blocks as summed up and obtained from the website http://sbm.gov.in/sbmreport/Report/Physical/SBM_VillageODFMarkStatus.aspx is tabled below:

Table 4-1: Status of Declared and Verified ODF Villages in Bankura

Sl. No	Block Name	Total Villages	Villages Not Existing	Declared ODF	Verified ODF	Not Declared ODF	Not Verified ODF
1	Bankura-I	147	10	0	0	137	137
2	Bankura-II	154	0	0	0	154	154
3	Barjora	200	0	0	0	200	200
4	Chhatna	287	0	16	0	271	287
5	Gangajalghati	163	0	0	0	163	163
6	Hirbandh	121	0	0	0	121	121
7	Indpur	217	0	1	0	216	217
8	Indus	131	0	19	0	112	131
9	Jaypur	138	0	0	0	138	138
10	Khatra-I	155	0	0	0	155	155
11	Kotulpur	169	0	0	0	169	169
12	Mejhia	75	0	0	0	75	75
13	Onda	286	0	0	0	286	286
14	Patrasayer	161	0	1	0	160	161
15	Raipur-I	207	0	107	5	100	202
16	Ranibundh	184	0	0	0	184	184
17	Saltora	157	1	0	0	156	156
18	Sarenga	165	14	0	0	151	151
19	Simlapal	205	1	0	0	204	204
20	Sonamukhi	177	0	0	0	177	177
21	Taldangra	146	0	0	0	146	146
22	Bishnupur	158	0	0	0	158	158
Total		**3803**	**26**	**144**	**5**	**3633**	**3772**

It is obvious, that the prevailing Toilet Coverage and Sanitation scenario look grim for Bankura, specifically in consideration that districts of North 24 parganas, Nadia, Midnapur East and Hooghly have been declared and verified as Open Defecation Free.

4.4 Solid and Liquid Waste Management and Way Forward

Solid & Liquid Waste Management (SLWM) is another major area of intervention to ensure cleanliness in the villages, considered under Mission Nirmal Bangla. Waste management is possible at the level of the household and at the level of the community. Household based waste management will mainly cater to the biodegradable solid waste and the liquid waste of individual households. In order to look at the larger perspective of SLWM it is necessary to understand the Sanitation scenario for the planning process. As an instance it is suggested to explore the option of Sanitation mapping including developing a Shit Flow Diagram for the larger clusters for improved planning of SLWM.

4.4.1 Sanitation Value Chain

It needs to be acknowledged that proper planning for SLWM needs to be implemented effectively to improve the Sanitation scenario overall. Disposal of Solid (Dry latrines, Septic Tanks etc) and liquid wastes (disposal of sullage through drains) and improved monitoring are essential elements that need to be looked into.

A comprehensive evaluation of the Sanitation System can be reflected if we look into the Sanitation value Chain, comprising of key steps involving (1) Containment (2) Emptying (3) Conveyance (4) Treatment and (5) End-Use / Re-Use /Disposal of faecal sludge and wastewater.A graphical representation of the steps involved in the Sanitation Value Chain is presented below:

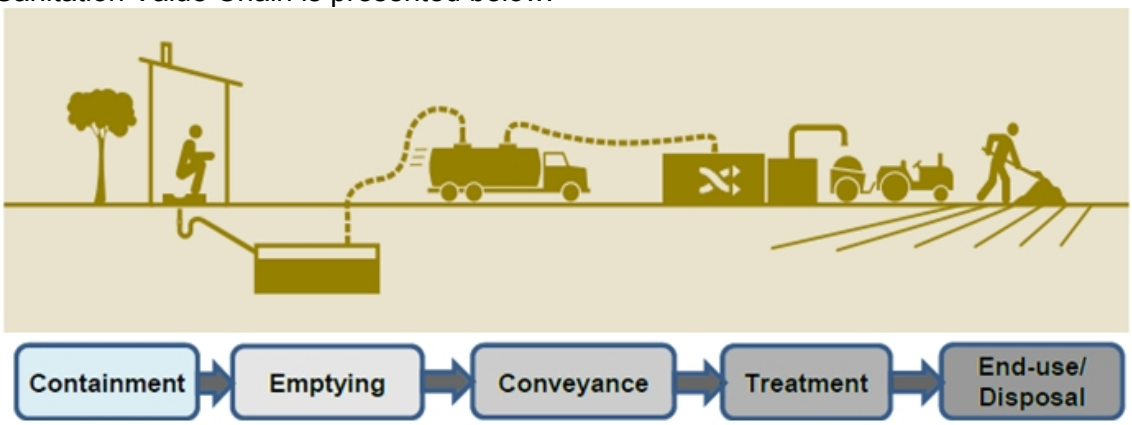
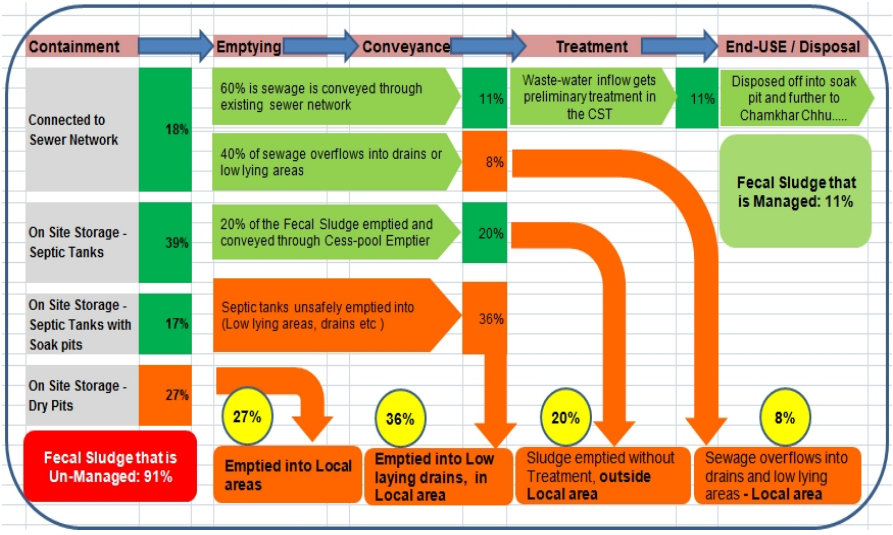


Figure 14: Sanitation Value Chain

4.4.2 Shit Flow Diagram

The Shit flow diagram (SFD) or the Fecal Waste Flow Diagram is a graphic representation of how the fecal waste (consisting of fecal sludge and wastewater) flows along the sanitation service chain.



Simple elemental practices can be taken up to improve the overall Sanitation Scenario at the Village level, with emphasis on re-cycle / re-use of sludge.

Figure 15: Shit Flow Diagram

Chapter 5 District Criticality Assessment

In rural areas potable water is primarily tapped from ground water, in the form of dug wells, hand pumps and shallow / deep tube wells. The rationale for abstraction of ground water is based on the significantlylower costs than developing surface water sources. Ground water usually requires less treatment than surface water(as turbidity and suspended solids are lower).

Most habitations continue to depend on these sources for their daily needs but they run the risk of getting affected by any ground water contamination (such as fluoride contamination in Bankura). Unless such contamination is detected through laboratory tests the communities will not know that continued use of groundwater impacts health.

The present Chapter deals with the critical issues faced by the various Blocks within the district as regards available water quantity and quality.

5.1 Blocks affected by Fluoride contamination

Based on the water quality test results and analysis, it may be inferred that pattern of fluoride contamination in the district varies from being severely affected to blocks which remain unaffected. A matrix has been framed to separate out the Blocks which are critically affected by fluoride contamination from those which are only moderately affected or unaffected.

The details of the severity of the Blocks affected by Fluoride contamination within Bankura is given below:

Table 5-1:Severity of Blocks affected by Fluoride Contamination

Sl. No	Fluoride Contamination	Name of Blocks	Number of Blocks
1	Critically affected	Bankura-II, Barjora, Chhatna, Gangajalghati, Hirbandh, Mejhia, Raipur, Saltora, Simlapal and Taldangra, Indpur,	11
2	Moderately affected	Bankura-I, Indus, Khatra, Onda, Sarenga and Sonamukhi	6
3	Un-affected	Bishnupur, Joypur, Kotulpur, Patrasayer and Ranibundh	5
		Total Number of Blocks	22

5.2 Blocks severely distressed by Ground Water availability

Based on the various investigations and lithological study (as provided in the Central Ground Water Board brochure), the blocks in Bankura can be categorized with respect to ground water potential to make an even comparison on the water security scenario. To make a fair assessment of the criticality of the Blocks, it is imperative that a broader framework be prepared and emphasis be provided to the blocks which are severely water stressed.

Table 5-2: Ground Water Potential of Blocks in Bankura

Sl. No	Ground Water Potential	Name of Blocks	Number of Blocks
1	Poor	Bankura-I & II, Chhatna, Gangajalghati, Hirbundh, Indpur, Khatra, Mejhia, Onda, Ranibundh, , Saltora, Sarenga	12
2	Poor to medium	Joypur, Patrasayer, Raipur, Taldangra,	4
3	Medium to High	Barjora, Bishnupur, Indus, Kotulpur, , Simlapal, Sonamukhi,	6
		Total Number of Blocks	22

5.3 District Criticality Assessment

The Backward Regional Grant Fund (BRGF, Phase-I) has already been taken up, under the aegis of Government of India, to tackle the issue of fluoride contamination. The BRGF, Phase-I is a comprehensive scheme for piped water supply for selected 14 Blocks. It is now essential that provision be made for the remaining 8 Blocks in Bankura. Thus, the District Criticality Assessment distinguishes between:

(1) Blocks affected by fluoride contamination and not covered under ongoing BRGF

(2) Blocks affected by fluoride contamination and covered under ongoing BRGF

The assessment rationale is that planning for the blocks which are not currently provided with any piped water supply can be drawn up appropriately, with due consideration and prioritization based on the extent of ground water being contaminated with fluoride.

The criticality of fluoride contamination in the Blocks which are already under BRGF can also be assessed to determine how many of the schemes have ground water sources with associated risks and how many have been prepared considering surface / sub-surface sources, taking the overall sustainability of the sources into account.

5.3.1 Fluoride affected Blocks- Not Covered under BRGF

Out of the eight Blocks not covered under BRGF, the blocks of Mejhia, Gangajalghati, Taldangra and Indpur are affected with fluoride contamination. The details of water quality test results from tube wells and subsequent GIS Mapping has enabled the number of tube-wells and associated habitations that have been affected by fluoride contaminationto be determined.

Tables showing the habitations and affected populations in these four blocks are given in Annexure-10. The data provided therein has been taken from the PHED website.

5.3.2 Criticallity Assessment of Blocks- Not Covered under BRGF

To make an overall assessment of criticality, the remaining eight Blocks have been arranged in terms of the extent of Fluoride contamination as well as the ground water potential. The arranged matrix as regards criticality of the Blocks with respect to overall water quality and availability is presented below:

Table 5-3: Critically affected Blocks-Not under BRGF

Sl. No	Fluoride Contamination	Ground water potential			Remarks
		Poor	Poor to Medium	Medium to High	
1	Severe	Mejhia, Indpur Gangajalghati	Taldangra		Priority-1
2	Moderate		Sonamukhi		Priority-2
3	Unaffected		Joypur, Patrasayer	Kotulpur,	Priority-3

Four blocks, namely, Mejhia, Gangajalghati, Indpur and Taldangra require special attention while framing of WS Schemes based on groundwater, due to fluoride contamination.

The criticality is greater for Mejhia, Gangajalghati and Indpur, since the groundwater potential in these blocks is very poor. The groundwater potential in Taldangra block, varies from poor to medium, with only the eastern fringe of the block having improved groundwater potential.

5.3.3 Fluoride affectedBlocks covered under BRGF

Selected WS Schemes under BRGF (Phase-I) have been drawn up considering ground water as the preferred source. The risks overall in abstracting ground water from the fluoride affected habitations cannot be ruled out. Based on the ground water potential and extent of fluoride contamination, the table below gives an overall assessment of the criticality of the blocks.

Table 5-4: Critically affected Blocks-Under BRGF

Sl. No	Fluoride Contamination	Ground water potential		
		Poor	Poor to Medium	Medium to High
1	Severe	Bankura-II, Chhatna, Hirbandh, Saltora,	Raipur,	Simlapal, Barjora
2	Moderate	Bankura-I, Khatra, Onda, Sarenga		Indus
3	Unaffected	Ranibundh		Bishnupur,

Any WS Schemes drawn up (in the BRGF, Phase-I) with ground water as the possible source carry the risk of fluoride contamination. Overall, 12 of the 14 Blocks in Bankura are either severely (7 Blocks) or moderately (5 blocks) affected by fluoride contamination.

An assessment of the WS Schemes drawn up considering ground water source as the basis for piped Water Supply System is tabled below:

Table 5-5: WS Schemes based on Ground Water- Under BRGF

Sl. No	Name of Block	Total WS Schemes under BRGF	WS Schemes based on Ground Water	Fluoride Contamination
1	Indus	8	4	Moderate
2	Bishnupur	7	3	Un-affected
3	Onda	13	10	Moderate
4	Raipur	5	2	Severe
5	Sarenga	4	1	Moderate
6	Simplapal	4	1	Severe
		41	21	

NOTE:

1. The blocks of Hirbandh, Khatra and Ranibandh have Surface water sourced from Mukutmanipur Dam and select Schemes based on sub-surface water (from Kangsabati) as potential Sources.
2. An Integrated WS Scheme for Barjora, Bankura-I and II have been conceived under BRGF, Phase-I based on Surface water sourced from Durgapur barrage.
3. The WS Scheme for Saltora-Chhatna under BRGF contemplates use of sub-surface water of Damodar.

Thus, an assessed 21 Schemes have been based on ground water under BRGF, of which 18 Schemes are in the blocks which are either severely or moderately affected by fluoride contamination. This does call for improved water quality monitoring measures to detect risks due to fluoride contamination and create appropriate mechanisms to treat the water before it can be used for potable purposes.

The Blocks under BRGF, wherein improved measures for water quality monitoring are required are:

1. Simlapal and Raipur (Severely affected) and
2. Indus, Sarenga and Onda (Moderately affected)Simlapal and Raipur (Severely affected) and
3. Indus, Sarenga and Onda (Moderately affected)

Chapter 6 Planning for Piped WS System By PHED

6.1 Piped WS Schemes- Blocks Not Covered under BRGF

The PHED has prepared a comprehensive scheme based on available information for the eight Blocksnot covered under BRGF (and Sonamukhi Municipality), as part of its plan to cover the district with piped water supply system. Summary details of the number of schemes that have been drawn up by PHED are tabled below:

Table 6-1: Water Sources proposed to be tapped

Sl. No	Name of CD Block	Nos. of Schemes proposed	Potential Source Considered		Potential Surface / Sub-Surface Source tapped
			Surface / Sub-Surface	Ground	
1	Mejhia	01	01	-	Damodar
2	Gangajalghati				
3	Indpur	16	01	15	Silabati
4	Joypur	05	02	03	Dwarakeswar,
5	Kotulpur	07	02	05	Dwarakeswar
6	Patrasayer	05	02	03	Damodar, Dwarakeswar
7	Sonamukhi	09	04	05	Damodar
8	Taldangra	19	08	11	Silabati, Jaypanda, Purandar Canal,
Total		62	20	42	

The planning for the eight Blocks has been done based on the design year 2045, with per capita demand of 70 lpcd for rural areas and 135 lpcd for municipal areas (Sonamukhi Municipality). Based on the WS Schemes that have been drawn up, the water abstraction requirement of each block and the sources proposed to be tapped based on the planning for Bankura is tabled below:

Table 6-2: Water Demand of Block to be met from Ground Water

Sl. No	Block	Population 2011	Design Population	Raw Water Demand (In Mld)	Demand Met from	
					Surface / Sub-Surface Water	Ground Water
1	Mejhia	86188	123169	10.7	33.55	-
2	Gangajalghati	180974	258618	22.8		-
3	Indpur	138249	189467	17.2	0.94	16.2
4	Joypur	136669	190499	17.4	7.68	9.7
5	Kotulpur	158095	218794	19.8	5.54	14.2
6	Patrasayer	153076	212544	19.2	6.73	12.5
7	Sonamukhi	138167	193481	17.4	9.47	8.0
8	Taldangra	126242	176594	15.5	7.99	7.5
Total Rural		1117660	1563166	140.0	71.9	68.1
Municipality						
	Sonamukhi	29085	41563	6.6	6.56	-
Gross Total		1146745	1604729	**146.6**	**78.46**	**68.1**

Block-wise discussion of the WS Schemes as proposed under the Detailed Project Report is discussed herein:

6.1.1 Water Supply Scheme for Mejhia-Gangajalghati Block

The Mejhia Gangajalghati is an integrated water supply scheme to supply potable water to the blocks of Mehjia and Gangajalghati. Under the proposal, a new infiltration gallery is proposed just upstream of the existing Mejhia WS Scheme to tap the sub-surface water of Damodar. The raw water is then proposed to be pumped to a clear water reservoir, where it will be disinfected. The clear water will then be pumped to various storage reservoirs within the Blocks.

The entire command area has been divided into 16 Zones (7 zones in Mejhia, and 9 Zones in Gangajalghati). To each of these Zones, water will be supplied to a centrally located storage reservoir for further distribution.

The total abstraction from the proposed Infiltration Gallery is assessed to be 33.5 Mld. The existing Mejhia WS Scheme, Gangajalghati WS Scheme and Charadihi WS Scheme will be integrated into the proposed Scheme.

Figure 16: Proposed WS Scheme: Mejhia-Gangajalghati

6.1.2 Water Supply Scheme for Indpur Block

A total of 16 water supply schemes have been contemplated under the Indpur Block, of which 15 schemes are based on ground water. The Bandeuli WS scheme is the lone scheme that is based on the surface water from River Silabati by check dam and diversion storage.

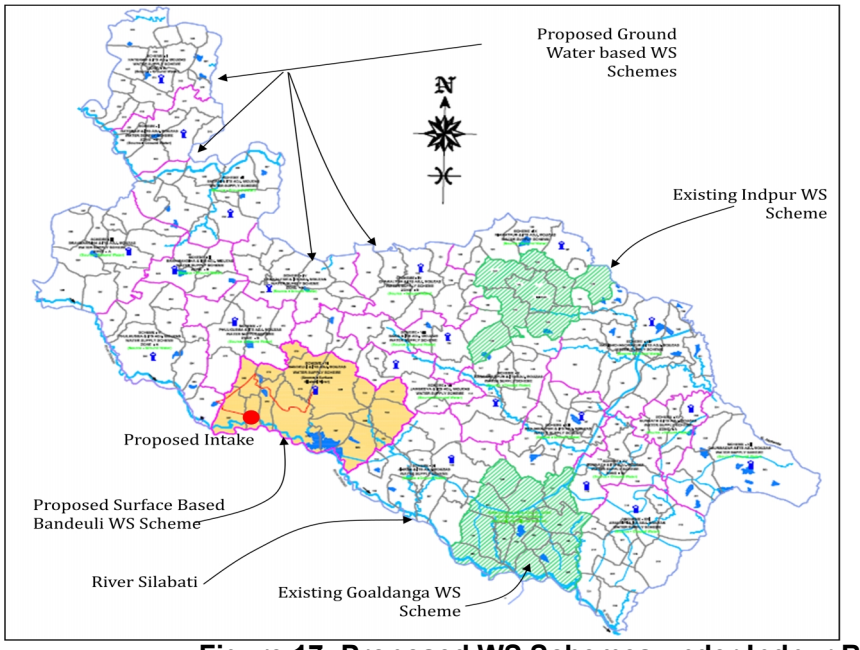


Figure 17: Proposed WS Schemes under Indpur Block

The existing Indpur WS Scheme (based on ground water) and Goaldanga WS Scheme (based on Sub-surface water of Silabati) are proposed to be retained. The total water

abstraction is assessed to be 17.2 Mld, of which around 1.0 Mld is will be for the Bandeuli WS Scheme and the balance 16.2 Mld abstracted from ground water through drilling of tube-wells.

6.1.3 Water Supply Scheme for Taldangra Block

A total of 19 Water Supply Schemes have been contemplated, of which 11 Schemes are based on ground water and the remaining 8 Schemes are dependent on Surface / Sub-surface flows.

A total of 3 Schemes have been drawn up from considering the sub-surface flow from River Silabati, whereas another 4 WS Scheme shall draw water from the Sub-surface flow of Jaypanda, and a lone WS Scheme has been proposed by tapping the flow from Purandar Canal.

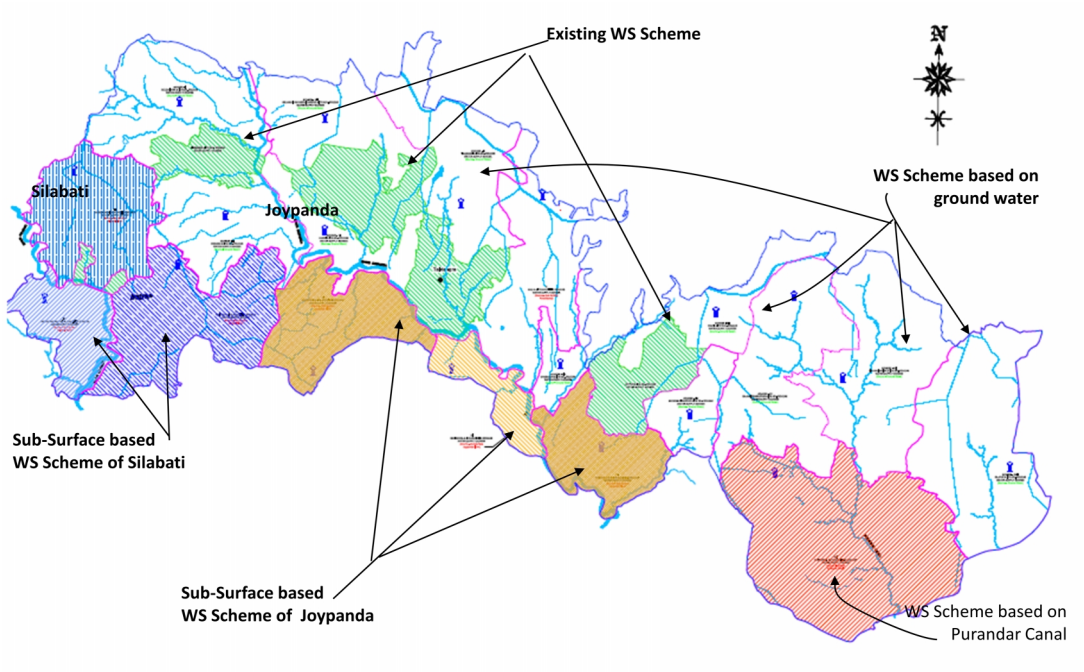


Figure 18: Proposed WS Schemes under Taldangra Block

Of the total water demand of 15.5 Mld, 8 Mld will be abstracted from sub-surface abstraction of River Joypanda and Silabati and the remaining from 7.5 Mld from ground water sources.

6.1.4 Water Supply Scheme for Sonamukhi Block

A total 9 Water Supply Schemes have been worked out for Sonamukhi Block. Of the 9 WS Schemes proposed, 4 WS Schemes (Rangamati, Bendelhati, Kundapuskari and Isabpur WS Scheme) are through Sub-surface abstraction from the River Damodar.

The Isabpur WS Scheme drawn up by abstraction of sub-surface water from Damodar,shall feed the Sonamukhi Municipality. The total demand met from ground water is 8.0 Mld, and the remaining 16 Mld to be sourced from Damodar, of which 5.5 Mld shall be for Sonamukhi Municipality.

An overall boundary of the WS Schemes drawn up for the respective Sub-surface WS Schemes is shown herein.

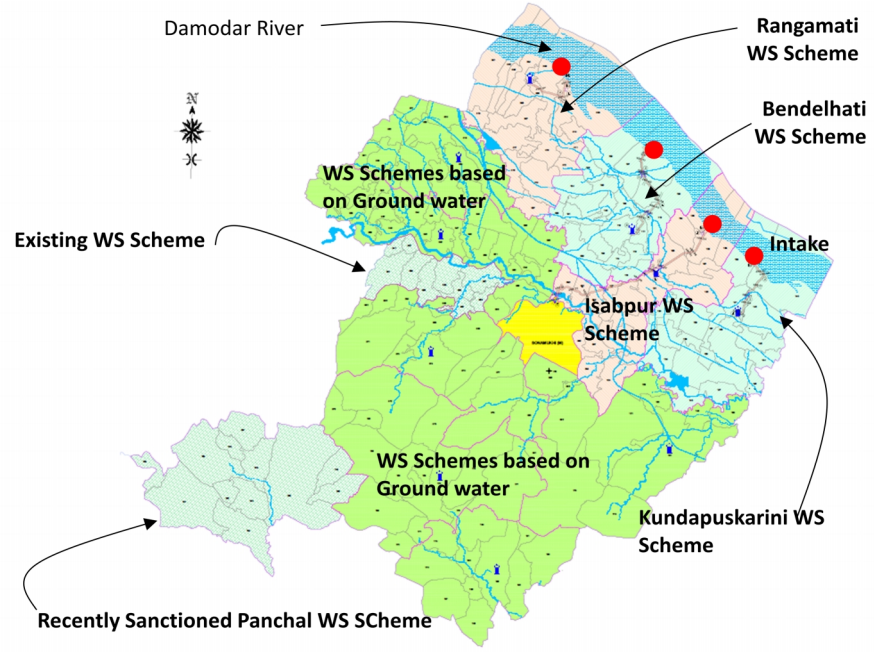
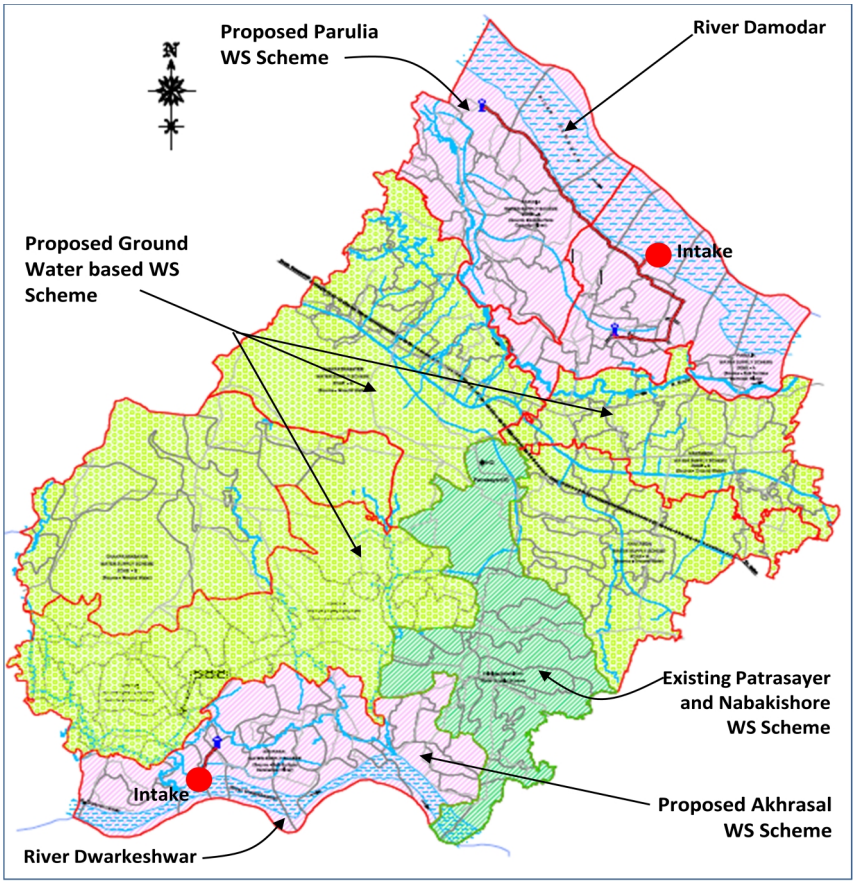


Figure 19: Proposed WS Scheme: Sonamukhi

6.1.5 Water Supply Scheme for Patrasayer Block

To cover the entire Block of Patrasayer, five independent schemes have been identified.



Of these five schemes, the Akrashal WS Scheme is based on tapping the Sub- surface water of Dwarakeswar River, the Parulia WS Scheme is based on tapping Sub-surface water from Damodar, while the remaining Schemes have been drawn considering ground water sources. The existing Nabakishore and Patrasayer WS Scheme, based on ground water are proposed to be retained.

Figure 20: Proposed WS Scheme: Patrasayer

The total abstraction is assessed to be 19.2 Mld, of which 4.1 Mld, is from Damodar, 2.7 Mld from Dwarkeshwar, and the remaining to be abstracted from ground water.

6.1.6 Water Supply Scheme for Joypur Block

Five Water Supply Schemes have been drawn up for Joypur Block, of which two Schemes (Routhkhanda and Raghunathpur WS Scheme) are based on Subsurface water of Dwarakeshwar River, and the remaining three have been based on available ground water resources.

The proposed water abstraction requirement for the Block is estimated at 17.4 Mld, of which 7.7 Mld is to be sourced from Dwarkeshwar. Existing 3 Number WS Schemes based on ground water sources are to be retained.

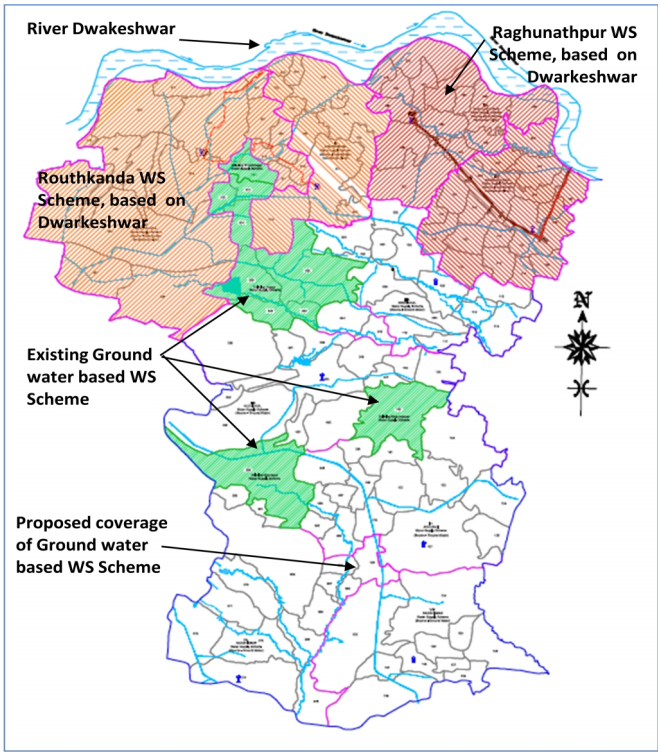


Figure 21: WS Scheme for Joypur

6.1.7 Water Supply Scheme for Kotulpur Block

A total of 7 Water Supply Schemes have been identified for Kotulpur Block. Of the 7 identified Water Supply Schemes, 2 have been based on Sub- surface water of Dwarakeswar River, whereas the remaining 5 Schemes are based on ground water.

The total design water demand is 19.8 Mld, of which 14.2 Mld shallbe met from ground water and the remaining 5.5 Mld from Dwarkeshwar.

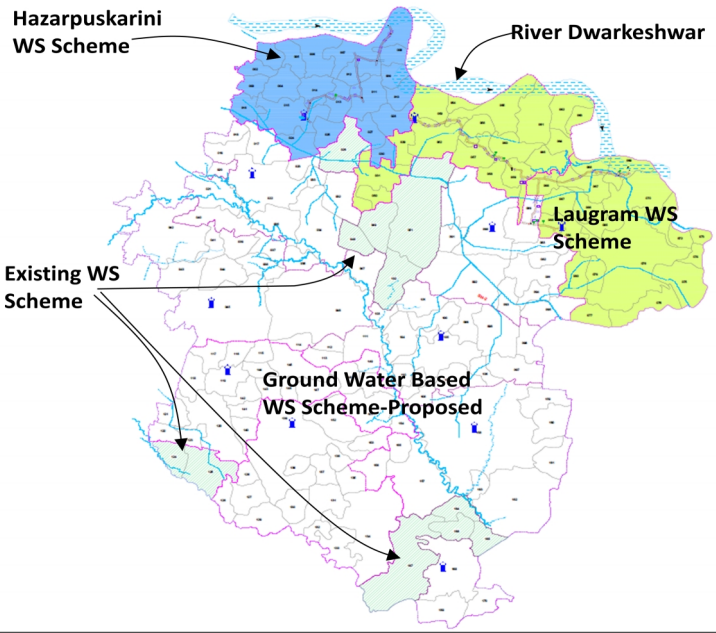


Figure 22: WS Scheme for Kotulpur Block

6.2 Components of the Schemes

6.2.1 WS System Components

The various Water System Components for Sub-Surface Water based Supply System shall consist of:

1. An Infiltration Gallery / Radial Collector Well
2. Water Treatment Plant
3. Clear Water Reservoir (CWR) cum Pumping Station
4. Over Head Storage Reservoir

Primarily, the Sub-Surface Water Based Schemes shall be divided into suitable number of zones for effective distribution of water. Each zone shall have smaller sub-zones, which shall be provided with a Storage reservoir.

Treated water will be pumped from the CWR to the zonal over head reservoirs directly or through the boosting pumping station as the case may be through rising main of adequate diameter. From the zonal over head reservoirs water will be supplied to the end users through adequately designed distribution network. The effort shall be to have the entire WS Distribution Network in a grid format to allow for interdependency of the System.

For Ground Water Based Schemes, the System Component shall consist of:

1. Deep Tube wells
2. Pressure Type Iron Removal Plants
3. Clear Water Reservoir (CWR) cum Pumping Station
4. Over Head Storage Reservoir

Possibility of allowing tube wells to be drilled at close proximity and treatment before conveyance to the villages / habitation will be preferred.

6.2.2 Infrastructure and Logistics

The Operation and Maintenance of the Schemes would require significant number of trained manpower and staff for the supply to be effectively monitored and managed. Provision for Staff quarters has been made for all operational staff. Since, the Piped Water Supply Schemes shall operate on a 24x7 basis, adequate provision for Operational Staff is required for Operation and Maintenance.

It is intended to have suitable accommodation arrangements for staff, deployed for the:

- Water Treatment Plants and
- Booster Pumping Stations

Some of the O&M personnel who would directly be involved for day and night service are to be provided with accommodation. In some places, it shall be necessary to provide with Guard sheds, camp accommodation of security/Police personnel.

Provision for Office, Go-down, Stack yard, Inspection Bungalows, Boundary wall with allied scheme etc. have been considered in the cost estimate of the proposed scheme.

6.3 Block Cost Estimates of the proposed Schemes

6.3.1 Basis of Estimation

The Cost Estimates have been arrived by sourcing the rates from the prevailing Schedule of Rates (SoR), published by the PHE Department, Government of West Bengal, including market rates for items, which are not available in the SoR.

Block Costs have also been considered for relevant work items and drawn up for similar works related to Civil, Electrical and Mechanical works as per ongoing practices of PHE Department. The Estimated Costs have been derived considering Electrical-Mechanical Costs to be 25% of Civil Costs.

The Estimated Costs includes Contingency (@ 3% of the Civil Costs), Lump sum Costs for IEC activities (of 5.0 Lakhs) and Land Costs.

6.3.2 Summary Wise Cost Estimate

The Estimated Cost of the proposed Schemes on Block basis is summed up below:

Table 6-3: Block Wise Cost Estimate

Sl. No:	Name of Block	Population (Census-2011)	Estimated Cost		Per Capita Cost	
			(Lakh INR)	(Million US$)	In INR	In US$
1	Mejhia	99727	9,143	13.4	6143	90
2	Gangajalghati	220002	10,497	15.4		
3	Indpur	189467	16,946	24.9	8944	132
4	Joypur	190499	8,448	12.4	4435	65
5	Kotulpur	218794	9,109	13.4	4163	61
6	Patrasayer	212544	8,746	12.9	4115	61
7	Sonamukhi	193481	9,549	14.0	4935	73
8	Taldangra	176594	10,941	16.1	6196	91
Total		1501108	83,380	122.5	5555	82

Chapter 7 Proposal for Surface Water utilization

7.1 Identification of Surface Sources

7.1.1 Rationale for Surface Water Utilization

One of the overarching goals of the Sub-mission for National Rural Drinking Water Programme (NRDWP) is to cover all arsenic and fluoride affected habitations with safe and perennial [25]surface water based piped water supply Schemes as a permanent and sustainable solution.

It has already been established, based on the Water Quality Test results, that the Blocks of Gangajalghati, Indpur and Taldangra, with Bankura are severely affected by fluoride contamination. The planning for the Proposed Water Supply Schemes has been based on the clustered location of the Blocks. The need for a surface water source, as a more promising and sustainable source, cannot be denied and the available options in the proximity of the affected Blocks must be examined.

7.1.2 Identification of Surface Source

Due to clustered location of the remaining 8 Blocks, the preparation process for a comprehensive Surface Based Water Supply Scheme can be planned in the form of 4 Clusters:

- Blocks of Mejhia-Gangajalghati
- Blocks of Indpur-Taldangra
- Blocks of Sonamukhi-Patrasayer and.
- Blocks of Joypur-Kotulpur

The rationale for the clustered study and assessment is that each of the clusters as identified are separated from each other (by existing Blocks) or rivers and possible integrated Water Supply Schemes (if required) could only be planned for the blocks within the Clusters.

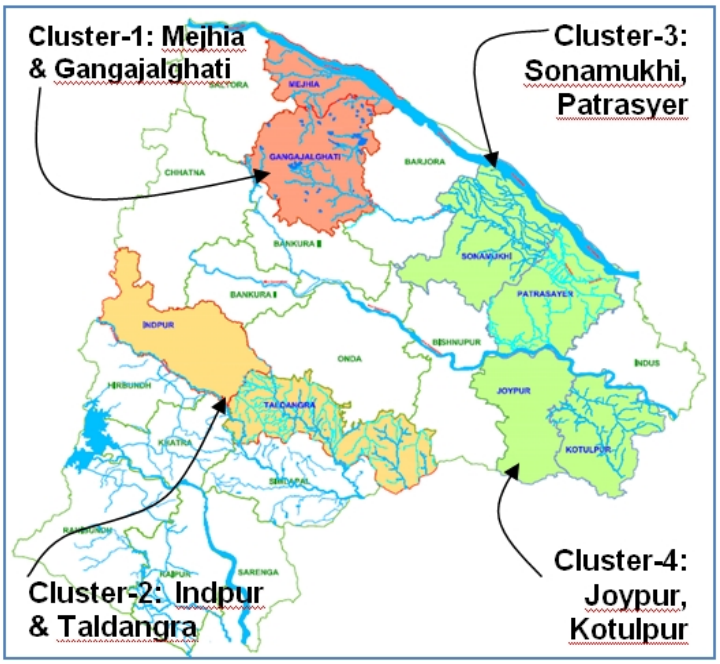


Figure23: Possible Clusters for Surface Based Schemes

It must be recognized that none of the rivers flowing through Bankura is perennial, due to the construction of dams / barrages. The Durgapur barrage (On Damodar) and the Mukutmanipur dam (On Kangsabati) are the only potential surface source abstraction points that have been utilized for surface based water supply schemes (Under BRGF, Phase-I). In hindsight, the only alternative option for abstracting surface water through sustainable means is conveyance of water from these impounding dams / barrages.

[25] Reference: Section-F, Sub-mission Guidelines

7.1.3 Surface-water based Schemesfor Mejhia-Gangajalghati Blocks

There are two rivers that flow in close proximity to Mejhia-Gangajalghati Blocks. The Damodar flows through the northern edge of Mejhia, whereas the River Sali flows through Gangajalghati. The Sali is rain-fed and not a perennial river whereas the Durgapur barrage upstream of Mejhia Block, impounds the flow of the river and used for Irrigation purposes, through the construction of a barrage.

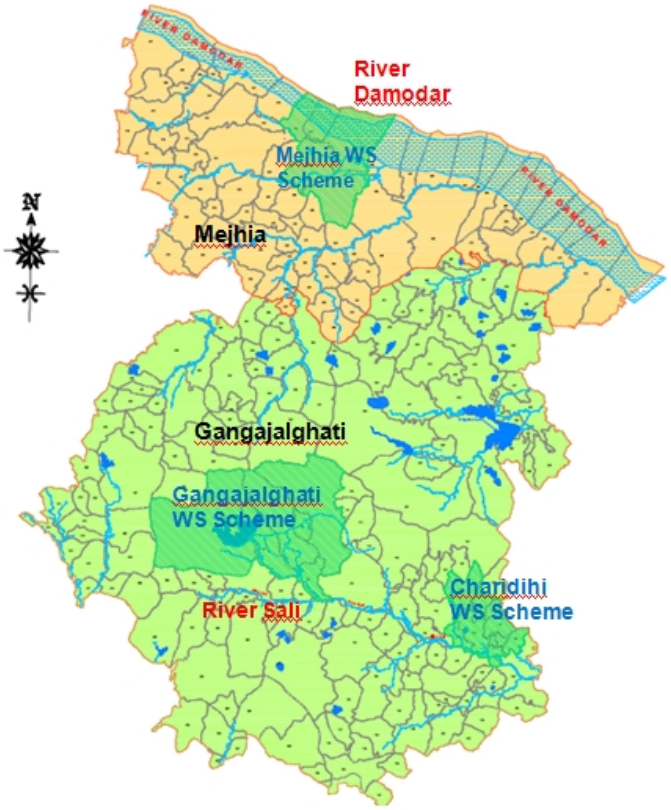


Figure24: Existing Surface Water Sources: Mejhia-Gangajalghati

Sustainable surface water source for the Block of Mejhia-Gangajalghati can be abstracted from the Durgapur barrage. The distance of the barrage from Gangajalghati is approximately 25 Kms, along the road through Barjora. There will be a need for pumping the water, as both the blocks are located at higher ground as compared to the barrage.

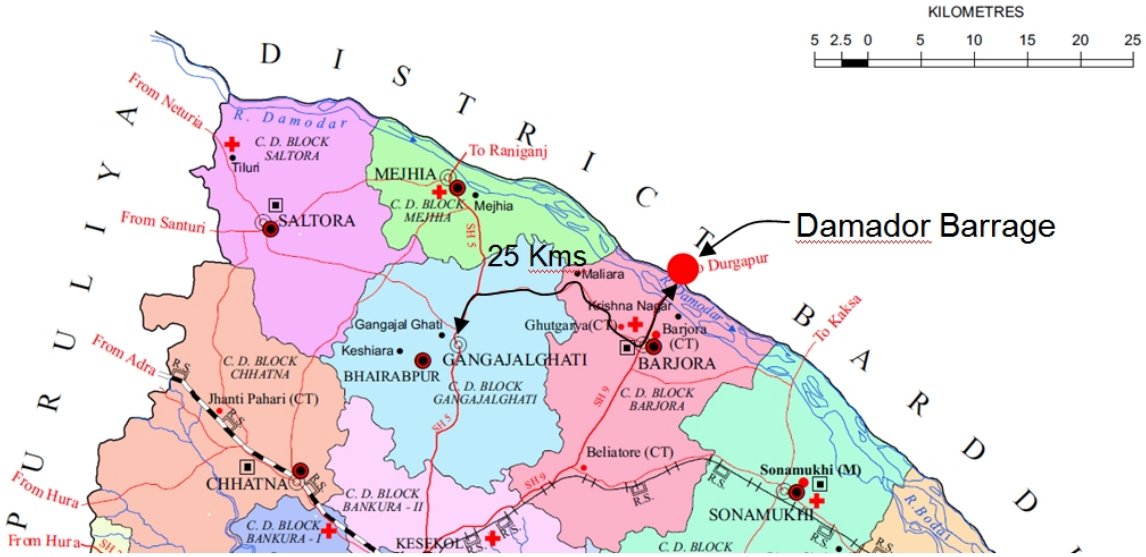


Figure25: Supply from Durgapur barrage to Mejhia-Gangajalghati Block

7.1.4 Surface-water based Schemesfor Indpur-Taldangra Blocks

The most notable river flowing through Indpur is the Silabati, which flows through the Southern tip of Indpur Block. The other 2 rivers are River Arakaha and Joypanda. However, the rivers are not perennial and as such unsuitable for surface water abstraction.

Sub-surface abstraction of Silabati has been considered for Indpur Block.

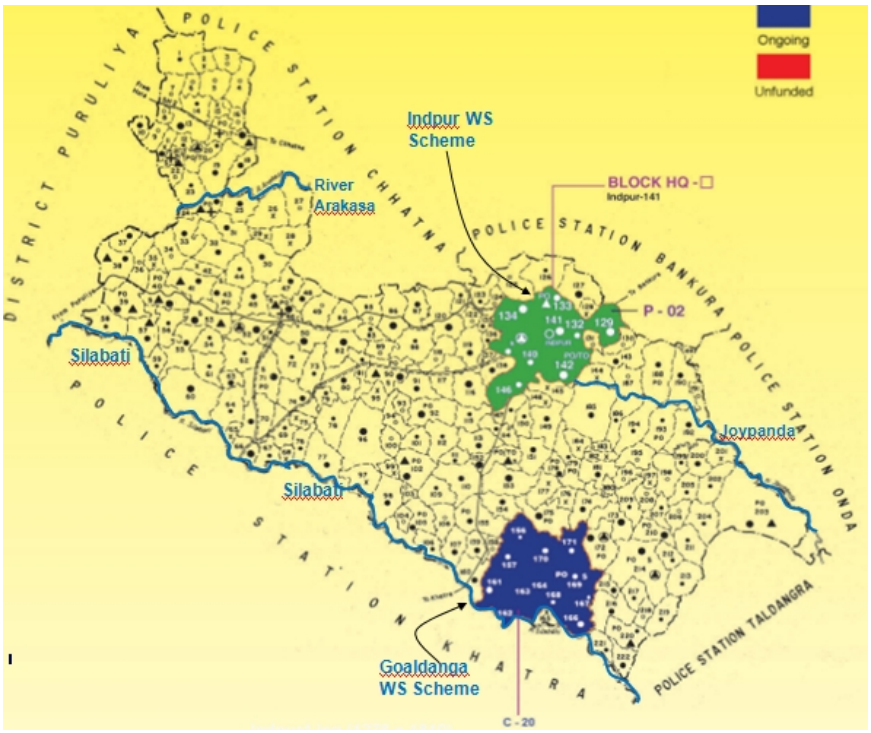


Figure26: Surface Water Sources in Indpur Block

The River Silabati flows through the eastern side of Taldangra, whereas River Jaypanda flows diagonally through Taldangra.

Figure27: Surface Water Sources in Taldangra Block

Since, the rivers are not perennial, sustainable surface water for the Indpur-Taldangra Block can be abstracted only from the Kangsabati dam. The distance of the dam near Mukutmanipur from Indpur is estimated at around 19 Kms along the road to Indpur Block.

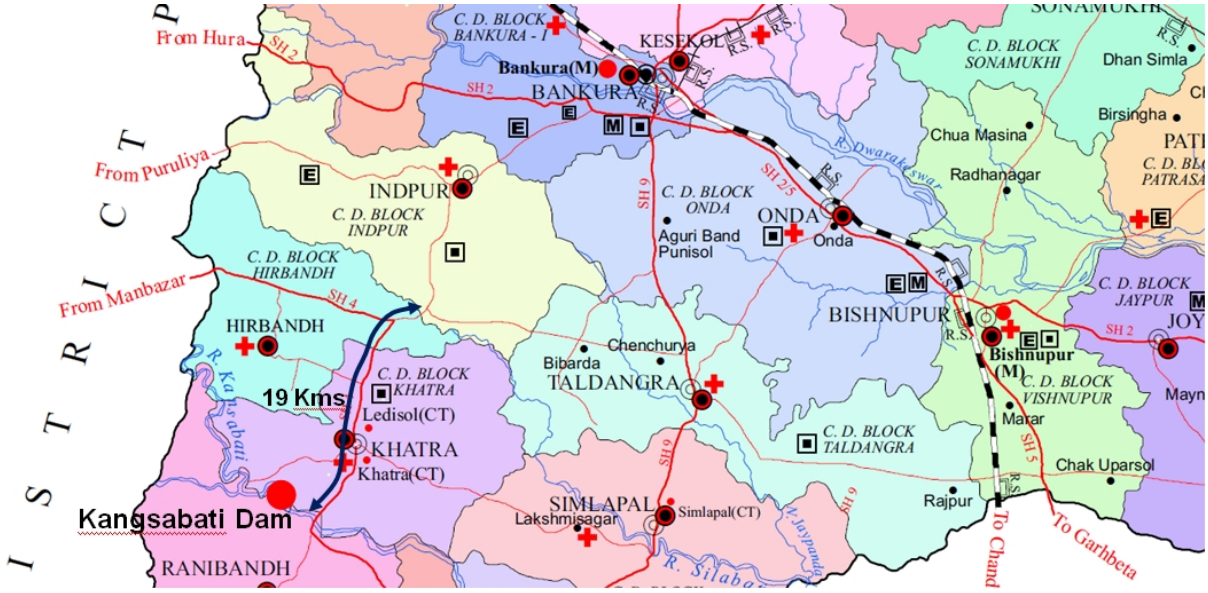


Figure 28: Distance of Indpur Block from Kangsabati Dam

7.1.5 Surface-water based Schemes-Sonamukhi-Patrasayer Blocks

Surface water for the Sonamukhi-Patrasayer block can be abstracted from the Durgapur barrage, as an alternative option (Based on availability). The distance of Sonamukhi Municipality from the barrage is around 35 Kms (through Barjora). A layout plan showing alignment of the transmission main along the road is shown below:

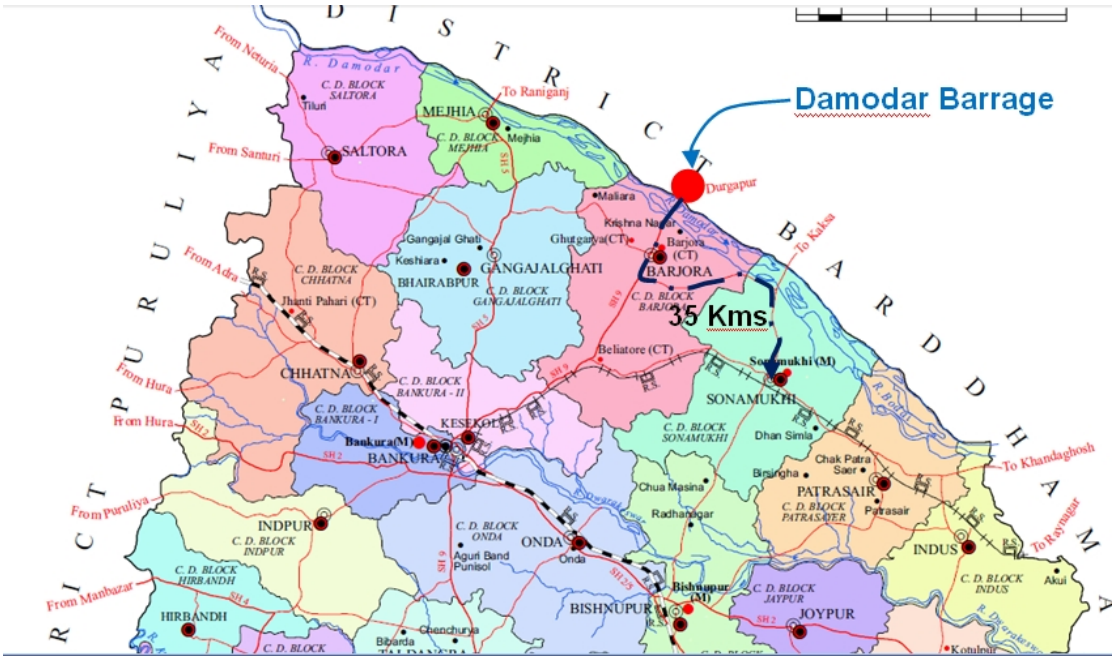


Figure 29: Distance of Sonamukhi from Durgapur barrage

Since, the blocks are located at the downstream end; flow from Durgapur barrage can be conveyed by gravity. The blocks of Sonamukhi and Patrasayer are well connected through road network and as conveyance and framing an integrated bulk water supply system would not be critical.

7.1.6 Surface-water based Schemes-Joyur-Kotulpur Blocks

The Dwarkeshwar river flows through the northern edge of the blocks, separating the twin blocks from Patrasayer and Indus. The Dwarkeshwar is not a perennial river. The Damodar river remains the only reliable surface water source for Joypur and Kotulpur. The twin blocks of Joypur and Kotulpur are at a distance of approximately 100Kms from the Durgapur barrage. Accessibility to both the blocks from Durgapur barrage has to either through Bishnupur block or through Indus block, crossing the Dwarkeshwarriver. An indicative layout plan showing a tentative alignment of the transmission main for conveyance of the water is shown.

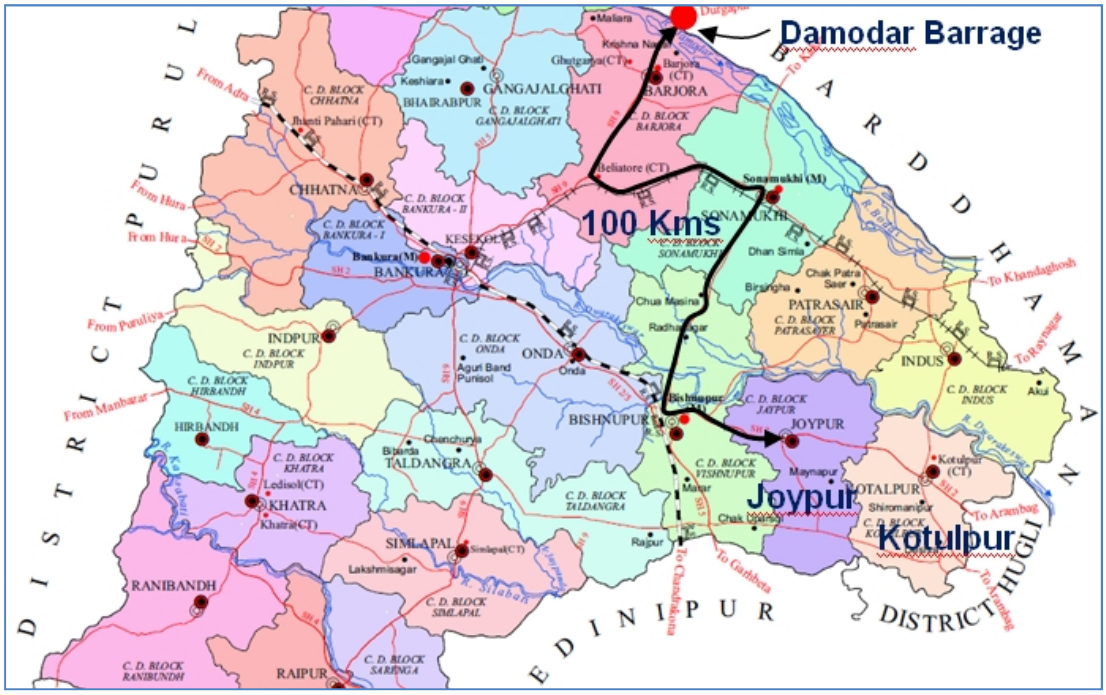


Figure 30: Layout plan showing pipe alignment from Durgapur barrage

7.2 Viability of the Surface Based Water Supply Schemes

Based on the demand assessment, in case, the surface based water supply schemes are to be taken up the (fore-casted) demand to be met is tabled below:

Table 7-1: Abstraction Requirement from Surface-water Sources

Sl. No	Name of Blocks	Assessed Raw water Demand (In Mld) to be met from	
		Durgapur Barrage	Kangsabati Dam
1	Mejhia-Gangajalghati	33.6	-
2	Indpur-Taldangra	-	32.7
3	Sonamukhi-Patrasayer	43.2	-
4	Joypur-Kotulpur	37.2	-
Total		**114.0**	**32.7**

It may be noted that based on the works undertaken in BRGF, Phase-I, 74 Mld of Water is being abstracted for Bankura-I, Bankura-II and Barjora blocks from Durgapur barrage, whereas 27 Mld of water is being withdrawn from Kangsabati dam for the integrated WS Scheme for Hirbandh, Khatra and Ranibandh.

The assessment of viability of the Integrated bulk water supply schemes based on Surface water sources can be taken up for study, investigation and feasibilityconsidering the availability of water in the dams (Durgapur barrage and Kangsabati dam)and to allow

for conveyance to the select blocks with possible alternative options to be explored based on assessment for

- Abstraction of water from blocks with potential Ground water availability, which however is contamination with Fluoride and Iron
- Abstraction of water from blocks with potential Ground water availability and wherein ground water is not contaminated with Fluoride (And Iron)
- Ground water potential is poor and demand cannot be met from the sources, and alternatives have to be considered.

This apart, the availability of abstraction of water from the sub-surface of the rivers, Damodar, Dwarkeshwar, Kangsabati, Silabati need to be assessed, through hydro-geological investigations to confirm its sustainability in the long term.

In order to prepare the frame work, for which source would be more viable and economical, data / information on the water availability from the potential sources needs to be collated and analysed.

7.3 Assessment of proposals framed and alternatives

Based on the proposals framed by PHED, it would be worthwhile to look into the overall water demand for the blocks, as well the percentage of the demand that is assessed to be met from ground water sources.

Table 7-2: Water Demand of Block to be met from Ground Water

Sl. No	Block	Raw Water Demand (In Mld)	Demand Met from		% of Demand from Ground Water
			Surface / Sub-Surface Water	Ground Water	
1	Mejhia	10.7	33.6	-	0%
2	Gangajalghati	22.8		-	0%
3	Indpur	17.2	0.9	16.2	95%
4	Joypur	17.4	7.7	9.7	56%
5	Kotulpur	19.8	5.5	14.2	72%
6	Patrasayer	19.2	6.7	12.5	65%
7	Sonamukhi	24.0	9.5	8.0	46%
8	Taldangra	15.5	8.0	7.5	48%
Total		146.6	71.9	68.1	46%

It will be interesting to note the suggestive water abstraction plan from sub-surface sources contemplated under the proposals. Details of the proposed abstraction from the various rivers are tabled below:

Table 7-3: Proposed Sub-surface water Abstraction Plan

Sl. No	Name of Block	Proposed Sub-surface water abstraction Plan (In Mld)			
		Damodar	Dwarkeshwar	Silabati	Joypanda
1	Mejhia	33.6			
2	Gangajalghati				
3	Indpur	-			
4	Taldangra	-		2.8	3.3
5	Sonamukhi	9.5			
6	Patrasayer	4.1	2.7		
7	Joypur		7.7		
8	Kotulpur		5.5		
Total Sub-surface Water Abstraction Plan		47.1	15.9	2.8	3.3

In continuation, it would be worthwhile to look into the critically of abstracting ground water from the blocks, wherein Schemes have been proposed to be based on ground water.

Table 7-4: Criticality Assessment: Water Demand met by Ground Water

Sl. No	Block	Ground Water Demand	% of Water Demand to be from Ground Water	Ground Water Potential	Is Ground Water Contaminated
1	Mejhia	-	0%	Poor	Yes
2	Gangajalghati	-	0%	Poor	Yes
3	Indpur	16.2	95%	Poor	Yes
4	Joypur	9.7	56%	Good	No
5	Kotulpur	14.2	72%	Good	No
6	Patrasayer	12.5	65%	Good	No
7	Sonamukhi	8.0	46%	Good	No
8	Taldangra	7.5	48%	Poor to Good	Yes
Total		**68.1**	**46%**		

It is clear that based on the proposals framed by PHED, the blocks of Indpur and Taldangra faces issues related to ground water, both in terms of ground water availability and contamination.

As such, it would be prudent to explore options for surface water abstraction for the block of Indpur and Taldangra to reduce the risks related to ground water availability, fluoride contamination and associated risks.

7.4 Ground Water Prospects and availability

Select sub-sections of the paragraphs presented herein are extracts prepared and framed by the State Water Investigation Department (SWID) based on Ground water prospect maps.

7.4.1 Indpur and Taldangra

These two blocks of Indpur and Taldangra essentially comprise of the granitoid gneiss and mica schist which are overlain by the laterites.

The Indpur block essentially comprises of the Buried Pediplain Shallow (BPS) and Buried Pediplain Medium (BPM) geomorphic units which are developed on the Granitoid Gneisses.

The Taldangra block essentially comprise of geomorphic units being Dissected Lateritic Upland (DLU) and Lateritic Plain (LP). In Taldangra block, the Buried Pediplain Shallow (BPS) and Buried Pediplain Medium (BPM) units corresponding to the Granitoid Gniesses and Mica Schists are concentrated along the western margin of the block.

The ground water prospect map for Indpur and Taldangra is shown below:

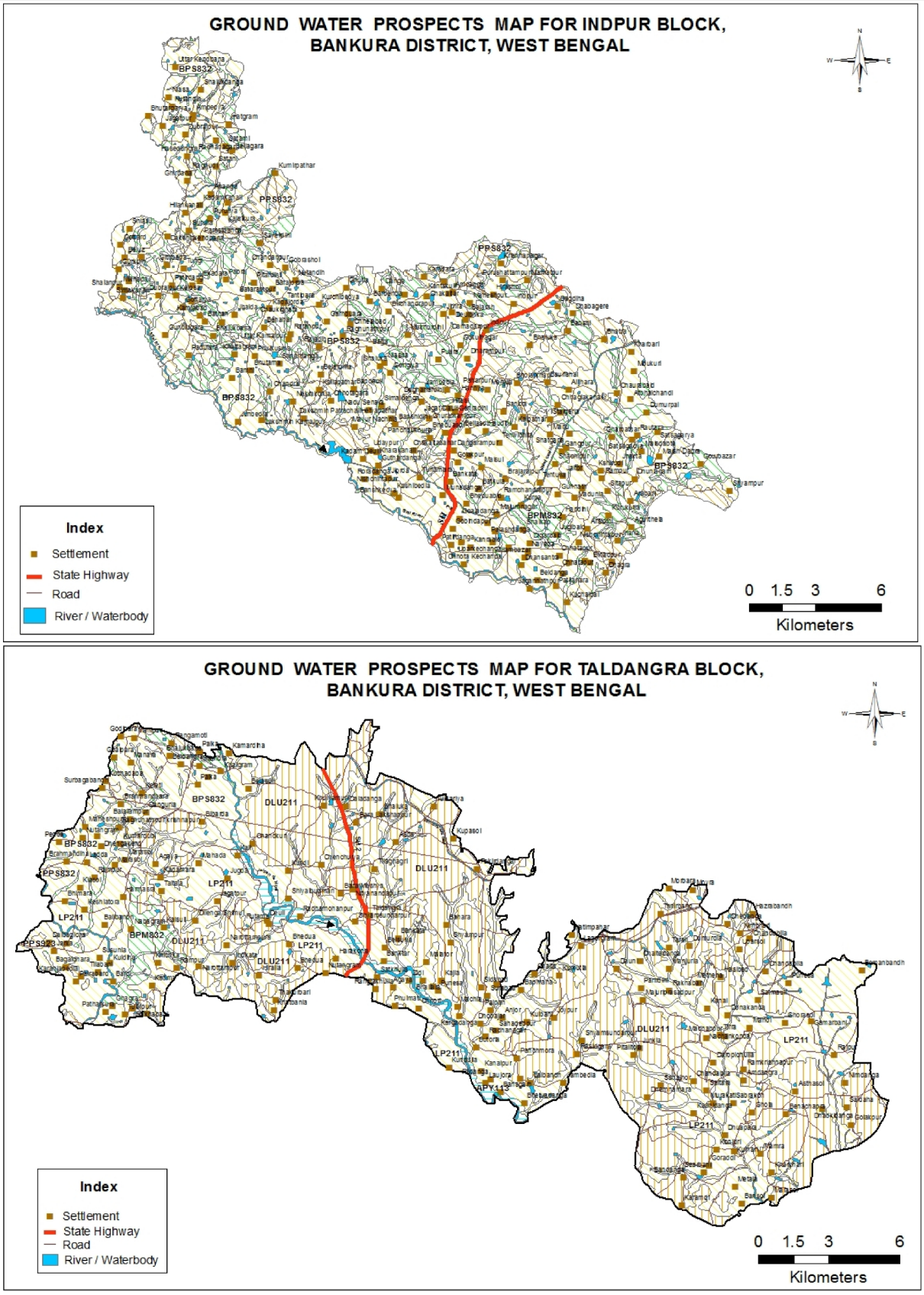


Figure 31: Ground Water Prospect Map: Indpur and Taldangra

The ground water prospects for each of the hydro-geomorphic unit and expected yield range in Indpur block is provided below:

MAP UNIT (HYDROGEOMORPHIC UNIT) REPRESENTED IN THE MAP WITH ALPHANUMERIC CODE (COLOUR INDICATES YIELD RANGE AND HATCHING INDICATE DEPTH RANGE)	GEOLOGICAL SEQUENCE / ROCK TYPE (REPRESENTED IN THE MAP WITH NUMERIC CODE)		GEOMORPHIC UNIT / LANDFORM (REPRESENTED IN THE MAP WITH ALPHABETIC CODE)	DEPTH RANGE OF WELLS (SUGGESTED) MIN - MAX (IN METERS)	YIELD RANGE OF WELLS (EXPECTED) (in LPM or m^3/ day)	REMARKS (PROBLEMS / LIMITATIONS)
LP211	Lalgarh/Illambazar Formation (Middle to Upper Pleistocene)	Laterite (Ferricrete-Hard crust, lateritic nodules & lithomarge clay) (211)	Lateritic Plain (LP) (Lithomarge Clay)	50 - 60 m	50 - 100 LPM	Recharge wells have high priority as the lithomarge clay layer needs to be penetrated to recharge underlying aquifer formed of weathered material and fractured rock.
VFS832	Chhotanagpur Gneissic Complex (Lower Proterozoic-2300 - 2400 mill.yrs.)	Granitoid Gneiss (832)	Valley Fill Shallow (VFS)	30 - 50 m	150 - 175 LPM	Prospects inferred as no wells observed. Recharge condition is moderate with moderate groundwater prospects
BPM832			Buried Pediplain Moderate (BPM)	40 - 50 m	150 - 175 LPM	Small units, recharge structures not required
BPS832			Buried Pediplain Shallow (BPS)	40 - 60 m	75 - 100 LPM	Recharge structures will improve sustainability of groundwater sources.
PPS832			Weathered Pediplain Shallow (PPS)	40 - 60 m	30 - 50 LPM	Due to high run-off and poor infiltration, recharge structures are required to maintain sustainability of groundwater sources

Figure 32: Hydro-geomorphic unit for Indpur block

The ground water prospects for each of the hydro-geomorphic unit and expected yield range in Taldangra block is provided below:

MAP UNIT (HYDROGEOMORPHIC UNIT) REPRESENTED IN THE MAP WITH ALPHA NUMERIC CODE (COLOUR INDICATES YIELD RANGE AND HATCHING INDICATE DEPTH RANGE)	GEOLOGICAL SEQUENCE / ROCK TYPE (REPRESENTED IN THE MAP WITH NUMERIC CODE)		GEOMORPHIC UNIT / LANDFORM (REPRESENTED IN THE MAP WITH ALPHABETIC CODE)	DEPTH RANGE OF WELLS (SUGGESTED) MIN - MAX (IN METERS)	YIELD RANGE OF WELLS (EXPECTED) (in LPM or m^3/ day)	REMARKS (PROBLEMS / LIMITATIONS)
CB111	Present day Deposits (Present Day)	Alluvium (Sand Dominant) (111)	Channel Bar (CB)	5-10 m	400-500 LPM	Groundwater prospects very high with high recharge potential. Recharge structures not required.
APY113	Panskura Formation Early to Late Holocene	Alluvium (Sand and Silt) (113)	Alluvial Plain Younger (APY)	25 - 30 m	200-250 LPM	Potable water available at shallow depth.
VFS211	Lalgarh/Illambazar Formation (Middle to Upper Pleistocene)	Laterite (Ferricrete-Hard crust, lateritic nodules & lithomarge clay) (211)	Valley Fill Shallow (VFS)	40 - 50 m	50 - 100 LPM	Recharge structure will increase the sustainability of ground water prospects
LP211			Lateritic Plain (LP) (Lithomarge Clay)	50 - 60 m	50 - 100 LPM	Recharge wells have high priority as the lithomarge clay layer needs to be penetrated to recharge underlying aquifer formed of weathered material and fractured rock.
DLU211			Dissected Lateritic Upland (DLU) (Hard crust and Lateritic nodules)	80 -100 m	30 - 50 LPM	Essentially run-off zone where hard crust is present. Areas of lateritic nodules are recharge zones with deep water table conditions Primarily forest areas with sparse settements. Not suitable for large scale development of ground water.
VFS832	Chhotanagpur Gneissic Complex (LOWER PROTEROZOIC-2300 - 2400 millyrs.)	Granitoid Gneiss (832)	Valley Fill Shallow (VFS)	30 - 50 m	150 - 175 LPM	Prospects inferred as no wells observed. Recharge condition is moderate with moderate groundwater prospects
BPM832			Buried Pediplain Moderate (BPM)	40 - 50 m	150 - 175 LPM	Small units,recharge structures not required
BPS832			Buried Pediplain Shallow (BPS)	40 - 60 m	75 - 100 LPM	Recharge structures will improve sustainability of groundwater sources
PPS832			Weathered Pediplain Shallow (PPS)	40 - 60 m	30 - 50 LPM	Due to high run-off and poor infiltration, recharge structures are required to maintain sustainability of groundwater sources
VFS923	Singhbhum Group (LT. Proterozoic 2300-2400 millyrs)	Epidiorite Hornblende Schist and Mica Schist (92)	Valley Fill Shallow (VFS)	30 - 50 m	100 - 125 LPM	Prospects inferred as no well observed.Recharge condition is moderate with moderate groundwater prospects
BPS923			Buried Pediplain Shallow (BPS)	40 - 60 m	50 - 75 LPM	Recharge structure will improve sustainability of groundwater sources
PPS923			Weathered Pediplain Shallow (PPS)	40 - 60 m	30 - 50 LPM	Due to high run-off and poor infiltration, recharge structures are required to maintain sustainability of groundwater sources

Figure 33: Hydro-geomorphic unit for Taldangra block

7.4.2 **Sonamaukhi and Patrasayer**

Spatially, the northern and north-eastern part of Sonamukhi block comprises of the older and younger alluvial plain. The central, southern and south-western part of Sonamukhi block consists of dissected Lateritic Uplands and Lateritic Plains together with the Valley Fills. In these blocks, the minor landforms comprises of the Channel Bars, Point Bars and Natural Levees. The ground water prospect map of Sonamukhi block is presented below:

Figure 34: Ground water prospect map: Sonamukhi block

The ground water prospects for each of the hydro-geomorphic unit and expected yield range in Sonamukhi block is provided below:

MAP UNIT (HYDROGEOMORPHIC UNIT) REPRESENTED IN THE MAP WITH ALPHANUMERIC CODE (COLOUR INDICATES YIELD RANGE AND HATCHING INDICATE DEPTH RANGE)	GEOLOGICAL SEQUENCE / ROCK TYPE (REPRESENTED IN THE MAP WITH NUMERIC CODE)		GEOMORPHIC UNIT / LANDFORM (REPRESENTED IN THE MAP WITH ALPHABETIC CODE)	DEPTH RANGE OF WELLS (SUGGESTED) MIN - MAX (IN METERS)	YIELD RANGE OF WELLS (EXPECTED) (in LPM or m^3/ day)	REMARKS (PROBLEMS / LIMITATIONS)
CB111	Hugli Formation/Present day Deposits (Present Day)	Alluvium (Sand Dominant) (111)	Channel Bar (CB)	5-10 m	400-500 LPM	Groundwater prospects very high with high recharge potential. Recharge structures not required.
PB111			Point Bar (PB)	5-10 m	300-400 LPM	Groundwater prospects very high with high recharge potential. Recharge structures not required.
APY113	Panskura Formation (Early to Late Holocene)	Alluvium (Sand and Silt) (113)	Alluvium Plain Younger (APY)	25 - 30 m	200-250 LPM	Potable water available at shallow depth.
APO13	Sijua/Rampurhat Formation (Late Pleistocene -Early Holocene)	Alluvium (Sand, Silt & Clay) (13)	Alluvial Plain Older (APO)	40-60 m	150-200 LPM	Moderate groundwater potential at intermediate depths.
VFS211	Lalgarh/Illambazar Formation (Middle to Upper Pleistocene)	Laterite (Ferricrete-Hard crust, lateritic nodules & lithomarge clay) (211)	Valley Fill Shallow (VFS)	40 - 50 m	50 - 100 LPM	Recharge structure will increase the sustainability of ground water prospects
LP211			Lateritic Plain (LP) (Lithomarge Clay)	50 - 60 m	50 - 100 LPM	Recharge wells have high priority as the lithomarge clay layer needs to be penetrated to recharge underlying aquifer formed of weathered material and fractured rock.
DLU211			Dissected Lateritic Upland (DLU) (Hard crust and lateritic nodules) (211)	80 -100 m	30 - 50 LPM	Essentially run-off zone where hard crust is present. Areas of lateritic nodules are recharge zones with deep water table conditions Primarily forest areas with sparse settlements. Not suitable for large scale development of ground water.

Figure 35: Hydro-geomorphic unit for Sonamukhi block

Ground water potential in Sonamukhi block is moderate to good in the north and north-eastern fringe of the block, whereas ground water potential in south and south-western region (adjoining Bishnupur block) is poor.

Spatially, the northern and north-eastern part Patrasayer block comprises of the older and younger alluvial plain corresponding to the older and younger Alluvium. The central, southern and south-western part of Patrasayer block consists of Dissected Lateritic Uplands and Lateritic Plains together with the Valley Fills. The extreme south-south-eastern part of Patrasayer block comprises of Alluvial Plain Older and Alluvial Plain Younger. In these blocks, the minor landforms comprises of the Channel Bars, Point Bars and Natural Levees. The ground water prospect map of Patrasayer block is presented below:

Figure 36: Ground Water Prospect Map: Patrasayer block

The ground water prospects for each of the hydro-geomorphic unit and expected yield range in Patrasayer block is provided below:

MAP UNIT (HYDROGEOMORPHIC UNIT) REPRESENTED IN THE MAP WITH ALPHA NUMERIC CODE (COLOUR INDICATES YIELD RANGE AND HATCHING INDICATE DEPTH RANGE)	GEOLOGICAL SEQUENCE / ROCK TYPE (REPRESENTED IN THE MAP WITH NUMERIC CODE)		GEOMORPHIC UNIT / LANDFORM (REPRESENTED IN THE MAP WITH ALPHABETIC CODE)	DEPTH RANGE OF WELLS (SUGGESTED) MIN - MAX (IN METERS)	YIELD RANGE OF WELLS (EXPECTED) (in LPM or m^3/ day)	REMARKS (PROBLEMS / LIMITATIONS)
CB111	Hugli Formation/Present day Deposits (Present Day)	Alluvium (Sand Dominant) (111)	Channel Bar (CB)	5-10 m	400-500 LPM	Groundwater prospects very high with high recharge potential. Recharge structures not required.
PB111			Point Bar (PB)	5-10 m	300-400 LPM	Groundwater prospects very high with high recharge potential. Recharge structures not required.
APY113	Panskura Formation (Early to Late Holocene)	Alluvium (Sand and Silt) (113)	Alluvial Plain Younger (APY)	25 - 30 m	200-250 LPM	Potable water available at shallow depth.
NL13	Sijua/ Rampurhat Formation (Late Pleistocene -Early Holocene)	Alluvium (Sand, Silt & Clay) (13)	Natural Levee (NL)	20-30 m	200-250 LPM	Areas of good groundwater potential at shallow depth. Recharge good, recharge structures not required.
APO13			Alluvial Plain Older (APO)	40-60 m	150-200 LPM	Moderate groundwater potential at intermediate depths.
VFS211	Lalgarh/Illambazar Formation (Middle to Upper Pleistocene)	Laterite (Ferricrete-Hard crust, lateritic nodules & lithomarge clay) (211)	Valley Fill Shallow (VFS)	40 - 50 m	50 - 100 LPM	Recharge structure will increase the sustainability of ground water prospects
LP211			Lateritic Plain (LP) (Lithomarge Clay)	50 - 60 m	50 - 100 LPM	Recharge wells have high priority as the lithomarge clay layer needs to be penetrated to recharge underlying aquifer formed of weathered material and fractured rock.
DLU 211			Dissected Lateritic Upland (DLU) (Hard crust and lateritic nodules)	80 -100 m	30 - 50 LPM	Essentially run-off zone where hard crust is present. Areas of lateritic nodulesare recharge zones withdeep water table conditions Primarily forest areas with sparse settlements.Not suitable for large scale development of ground water.

Figure 37: Hydro-geomorphic unit for Patrasayer block

Ground water potential in Patrasayer block is moderate to good in the north and north-eastern fringe of the block, whereas ground water potential in south and south-western region (adjoining Bishnupur block) is poor.

7.4.3 **Joypur and Kotulpur**

Joypur Block

Spatially, the eastern part of Joypur block, comprises of the older and Younger Alluvial Plain corresponding to the Older and Younger Alluvium. The western part of the Joypur block consists of Dissected Lateritic Uplands and Lateritic Plains together with the Valley Fills. The Ground water prospect map of Joypur block is shown below:

Figure 38: Ground Water Prospect Map: Joypur block

The ground water prospects for each of the hydro-geomorphic unit and expected yield range in Joypur block is provided below:

MAP UNIT (HYDROGEOMORPHIC UNIT) REPRESENTED IN THE MAP WITH ALPHA NUMERIC CODE (COLOUR INDICATES YIELD RANGE AND HATCHING INDICATE DEPTH RANGE)	GEOLOGICAL SEQUENCE / ROCK TYPE (REPRESENTED IN THE MAP WITH NUMERIC CODE)		GEOMORPHIC UNIT / LANDFORM (REPRESENTED IN THE MAP WITH ALPHABETIC CODE)	DEPTH RANGE OF WELLS (SUGGESTED) MIN - MAX (IN METERS)	YIELD RANGE OF WELLS (EXPECTED) (in LPM or m^3/day)	REMARKS (PROBLEMS / LIMITATIONS)
CB111	Hugli Formation/Present day Deposits (Present Day)	Alluvium (Sand Dominant) (111)	Channel Bar (CB)	5-10 m	400-500 LPM	Groundwater prospects very high with high recharge potential. Recharge structures not required.
PB111			Point Bar (PB)	5-10 m	300-400 LPM	Groundwater prospects very high with high recharge potential. Recharge structures not required.
APY113	Panskura Formation (Early to Late Holocene)	Alluvium (Sand and Silt) (113)	Alluvial Plain Younger (APY)	25 - 30 m	200-250 LPM	Potable water available at shallow depth.
APO13	Sijua/Rampurhat Formation (Late Pliestocene-Early Holocene)	Alluvium (Sand, Silt & Clay) (13)	Alluvial Plain Older (APO)	40-60 m	150-200 LPM	Moderate groundwater potential at intermediate depths.
VFS211	Lalgarh/Illambazar Formation (Middle to Upper Pleistocene)	Laterite (Ferricrete-Hard crust, lateritic nodules & lithomarge clay) (211)	Valley Fill Shallow (VFS)	40 - 50 m	50 - 100 LPM	Recharge structure will increase the sustainability of ground water prospects
LP211			Lateritic Plain (LP) (Lithomarge Clay)	50 - 60 m	50 - 100 LPM	Recharge wells have high priority as the lithomarge clay layer needs to be penetrated to recharge underlying aquifer formed of weathered material and fractured rock.
DLU211			Dissected Lateritic Upland (DLU) (Hard crust and lateritic nodules) (211)	80 -100 m	30 - 50 LPM	Essentially run-off zone where hard crust is present. Areas of lateritic nodulesare recharge zones with deep water table conditions Primarily forest areas with sparse settlements.Not suitable for large scale development of ground water.

Figure 39: Hydro-geomorphic unit for Joypur block

Ground water potential is moderate in north and north-eastern fringe of the block, whereas ground water potential in south and south-western region (towards Bishnupur block) is poor.

Kotulpur Block

The entire block of Kotulpur comprises of the older and younger alluvial plain corresponding to the older and younger alluvium. The Ground water prospect map of Kotulpur block is shown below:

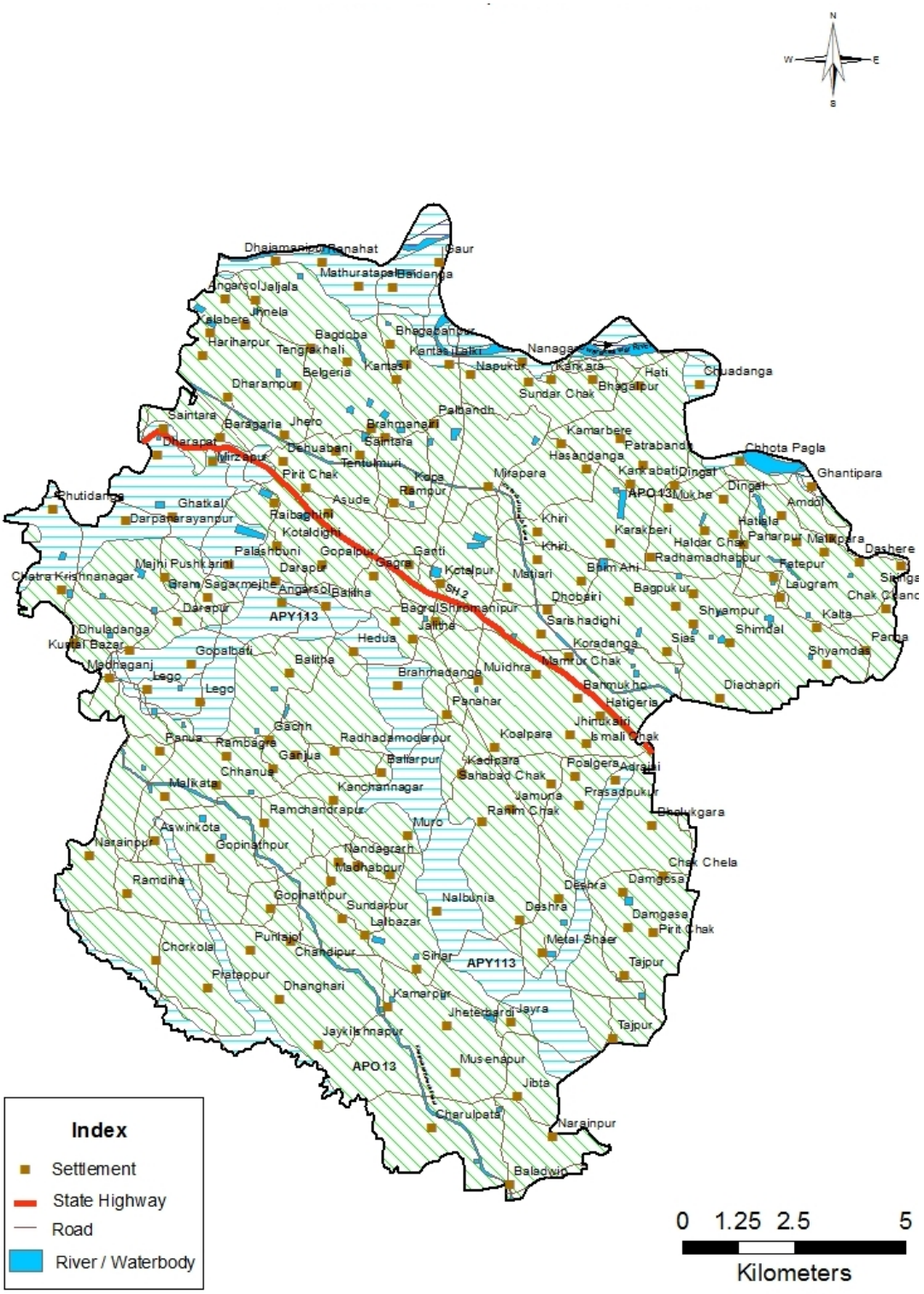


Figure 40: Ground Water Prospect Map: Kotulpur

The ground water prospects for each of the hydro-geomorphic unit and expected yield range in Kotulpur block is provided below:

MAP UNIT (HYDROGEOMORPHIC UNIT) REPRESENTED IN THE MAP WITH ALPHA NUMERIC CODE (COLOUR INDICATES YIELD RANGE AND HATCHING INDICATE DEPTH RANGE)	GEOLOGICAL SEQUENCE / ROCK TYPE (REPRESENTED IN THE MAP WITH NUMERIC CODE)		GEOMORPHIC UNIT / LANDFORM (REPRESENTED IN THE MAP WITH ALPHABETIC CODE)	DEPTH RANGE OF WELLS (SUGGESTED) MIN - MAX (IN METERS)	YIELD RANGE OF WELLS (EXPECTED) (in LPM or m^3/ day)	REMARKS (PROBLEMS / LIMITATIONS)
CB111	Hugli Formation/Present day Deposits (Present Day)	Alluvium (Sand Dominant) (111)	Channel Bar (CB)	5-10 m	400-500 LPM	Groundwater prospects very high with high recharge potential. Recharge structures not required.
PB111			Point Bar (PB)	5-10 m	300-400 LPM	Groundwater prospects very high with high recharge potential. Recharge structures not required.
APY113	Panskura Formation (Early to Late Holocene)	Alluvium (Sand and Silt) (113)	Alluvial Plain Younger (APY)	25 - 30 m	200-250 LPM	Potable water available at shallow depth.
APO13	Sijua/ Rampurhat Formation (Late Pleistocene to Early Holocene)	Alluvium (Sand, Silt & Clay) (13)	Alluvial Plain Older (APO)	40-60 m	150-200 LPM	Moderate groundwater potential at intermediate depths.

Figure 41: Hydro-geomorphic unit for Kotulpur block

Ground water availability in the block varies from moderate to very good.

7.4.4 Mejhia and Gangajalghati

The ground water prospects for the 2 blocks of Mejhia and Gangajalghati is based on the report prepared by School of Environmental Studies (SoES), Jadavpur University as part of the overall assessment of Ground water availability in selected 8 blocks of Bankura under the PHED.

Mejhia Block

The groundwater in Mejhia block is available in hard rock within joints fractures and fissures, developed in rocky beds. These anisotropic aquifers do not yield water sustainably and substantially. On the other hand, the flow dynamics are very complex, depending upon the pattern of joints and fractures/fissures. As a result, such areas are categorized 'drought prone'.

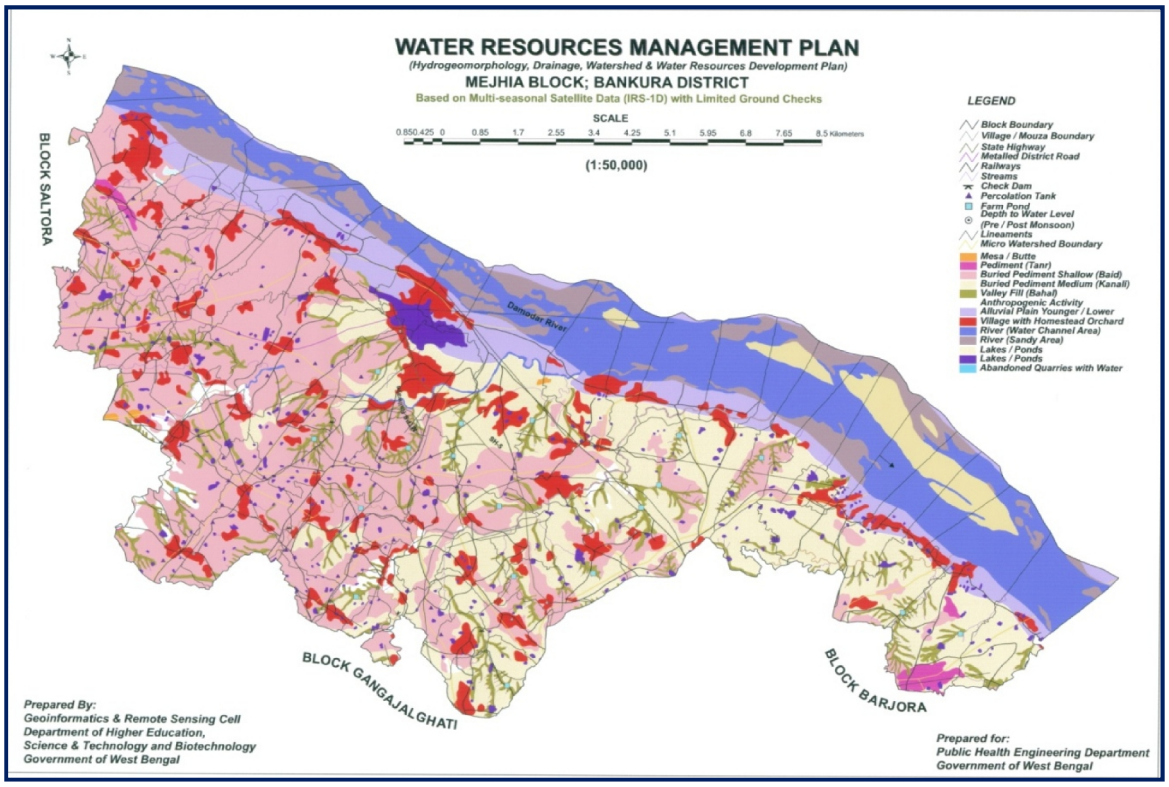


Figure 42: Ground Water Prospect Map: Mejhia

The hydro geological set up of Mejhia block is complex. The tube well water available within this block is by and large from the zones of rock bed fractures and joints of Gondwana group of rocks mainly sandstones.

Ground water prospect in the block is poor. The dependable groundwater storage is not available for Mejhia block to cater the future demand of drinking, industry and irrigation and ground water prospect for community based supply may not be sustainable.

Gangajalghati Block

The Geology of Gangajalghati block is hard and compact crystalline rocks. The exposures are found almost all the areas of the block. The lithounits are mainly granite gneiss with variety of augen gneiss, very coarse grained intrusives of pegmatite, quartzite etc. Chhottanagpur Gneissic Complex has suffered a polyphase of metamorphic deformation.

The overall groundwater availability in Gangajalghati may be evaluated as

(a) The groundwater storage is available within fracture, fissures and joints of the hard rock.
(b) The aquifers are anistropic in nature and flow dynamics is different from alluvial aquifers.
(c) Fractures zone may be continuous or dis-continuous in nature. The maximum depth (as it is understood) by inventory on few tube well 60 m to 75 m.
(d) In suitable spots where cross-joints are present aquifer yield may be substantial to small community water supply schemes as it has already been envisaged.

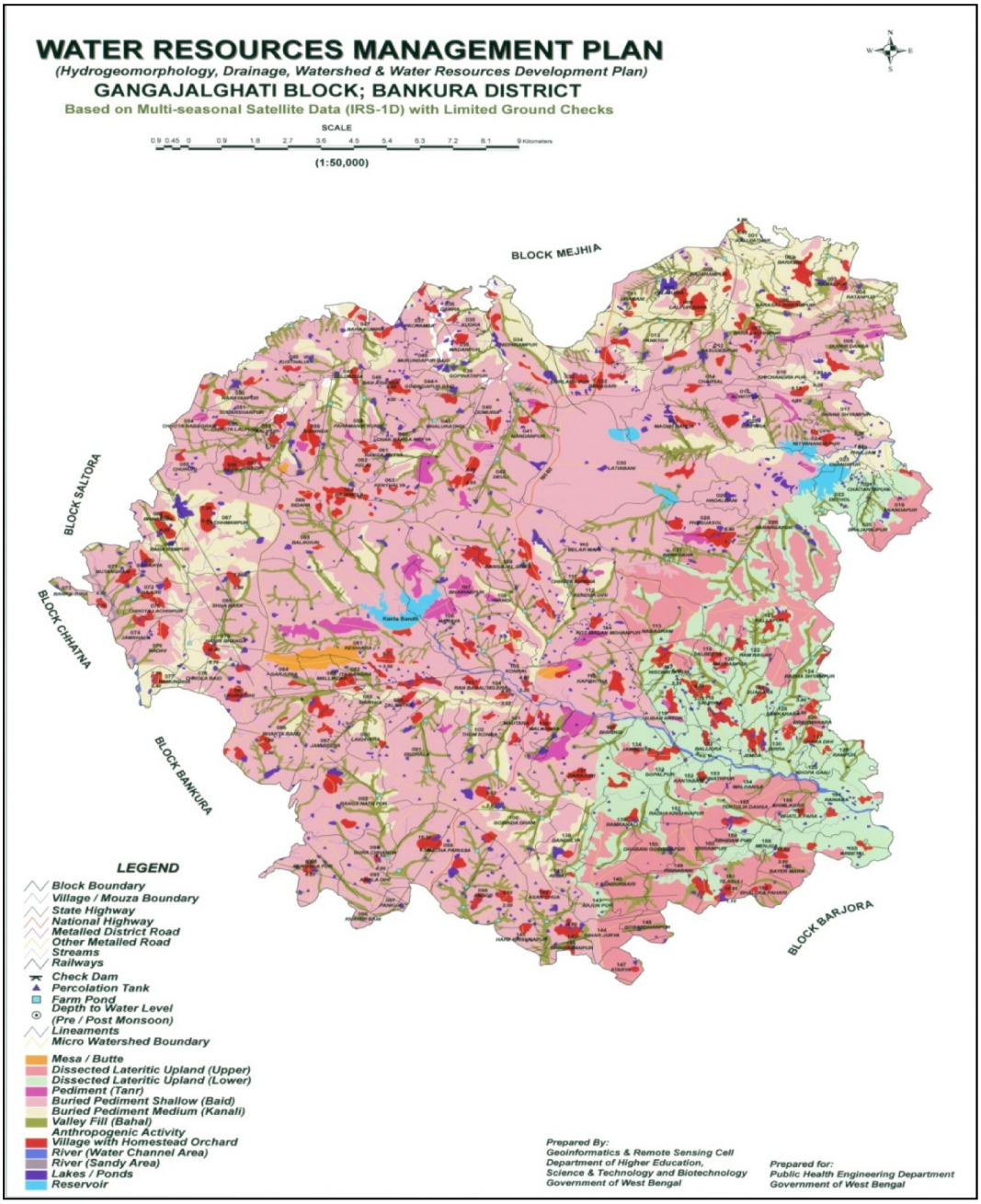


Figure 43: Ground Water Prospect Map: Gangajalghati

Large scale groundwater based community water supply scheme may not be sustainable in the block.

Chapter 8 Conservation and Demand Management

Water Conservation and Demand Management are key components related to Water Security. Indiscriminate ground water development including dependence on use of ground water (for agriculture and potable uses due to monsoon failures is accelerating ground water depletion). In order to tackle the burgeoning problem of water level decline, it is necessary to take up schemes for water conservation and artificial recharge to ground water on priority.

The need for Water Conservation and Demand Management in Bankura gains significance, since most of the blocks are water distressed. The CGWB in its report is explicit in stating that blocks of Chatna, Gangajalghati, Indpur, Hirbundh, Mejhia, Ranibundh and Saltora face severe water scarcity and are notable drought prone blocks.

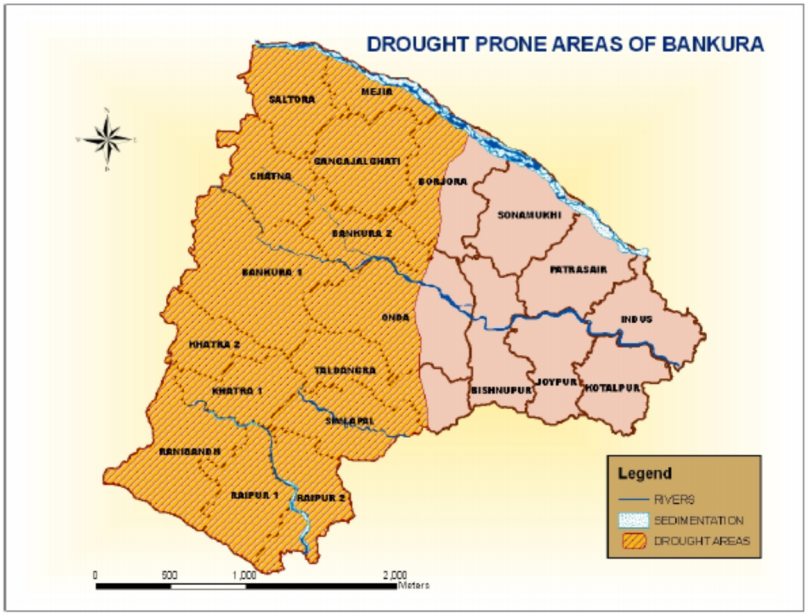


Figure 44: Drought prone areas of Bankura

Water Conservation involves a range of measures from provisional storage, Water harvesting, water re-use, water recycling to protection of water bodies. Primarily, water conservation measures are source related and ensuring reliability of source through various adaptive means. In contrast Demand Management is more related to end usage / consumption and its Control / regulation.

The relevance of Water Conservation and Demand management acquires more significance, since water availability / security is a key issue plaguing the district of Bankura. In the Section herein, we describe some measures related to Water Conservation and Demand Management including steps initiated in Bankura, primarily related to Water Conservation.

8.1 Conservation of Water

8.1.1 Studies required

In order to arrive at the suitability and appropriateness of the artificial re-charge structures, detailed study / information related to Remote Sensing techniques and through hydro-meteorological, hydrological, geophysical, hydro-geological and hydro-chemical investigations are required to ascertain the scope and feasibility of artificial recharge.

These studies are to be oriented in such a way as to collect and analyze necessary data, which are to be used as inputs for proper planning of artificial recharge projects.

Details of Studies required for Planning for Artificial Re-charge Structures are tabled below:

Table 8-1:Studies required for Planning of Artificial Re-charge Structures

Sl. No	Type of Study	Inputs Anticipated
1	Remote Sensing Studies	Spatial variation in the infiltration characteristics of various litho-units. Drainage characteristics and Lineament intensity. Distribution of various geomorphic units
2	Hydro-meteorological studies	Rainfall amount, duration, daily and hourly rainfall intensity, variability of rainfall
3	Hydrological Studies	Source water availability, infiltration characteristics of major soil types and various land use categories
4	Geo-physical studies	Thickness of weathered zone in hard rocks Thickness and characteristics of granular zones in sedimentary terrain. Stratification of aquifer system and spatial variability in hydraulic conductivity. Vertical hydraulic conductivity Discontinuities such as dykes and fault zones.
5	Hydro-geological Studies	Regional hydrogeology and aquifer characteristics Behaviour of ground water levels Ground water potential Ground water flow pattern and hydraulic connection between ground water and surface water bodies
6	Hydro-chemical Studies	Quality aspects of source water for artificial recharge. Spatial and temporal variations in ground water quality.

8.1.2 Suitability of Artifical Re-Charge Structures

The Central Ground Water Board (CGWB) has recommended various artificial recharge methods and structures, suitable for different slope categories, aquifer types and amount of precipitation received. Since, the annual rainfall for Bankura is more than 1000mm, the abstracts as recommended maybe considered. A matrix suitable for Bankura as abstracted is presented in Annexure-11.

A brief discussion on the more common Water Conservation methods suitable for Bankura and adopted is discussed herein:

8.1.3 Construction of Check Dams

Check Dams are constructed across gullies, nalahs or streams to check the flow of surface water in the stream channel and to retain water for longer durations in the pervious soil or rock surface.

The check dams are constructed primarily in areas having gentle slopes. Competent civil and agro-engineering techniques are to be used in the design, layout and construction of permanent check dams to ensure proper storage and adequate outflow of surplus water to avoid scours on the downstream side for long-term stability of the dam.

Figure 45: Check Dam in Bankura

The CGWB in-fact has made strong recommendations on construction of Check damat specific intervals in the drainage channels of Kangsabati river.Silabati, Joypanda, Tarafeni, Burai etc.The use of Check Dams has been in practice in Bankura. Some of the more notable Check Dams in Bankura are:

Table 8-2: Check Dams in Bankura

Sl. No	Block	Name of Check Dam
1	Bishnupur	Jamuna Bandh, Krishna bandh, Lalbandh, Kalindi Bandh, Shyam Bandh, Poka Bandh, Gantait Bandh
2	Ranibandh	Manj Bandh
3	Joypur	Samudra Bandh
4	Raipur	Jamuna Bandh
5	Patrasayer	Danna Bandh
6	Onda	Raj Bandh
7	Barjora	Sitala Bandh, Krishna Bandh
8	Kotulpur	Mayer Dighi Bandh

8.1.4 Percolation Tanks

Percolation tanks are the most common runoff harvesting structure in India. These are artificially created surface water body submerging a highly permeable land area so that the surface runoff is made to percolate and recharge the ground water storage. They are not provided with sluices or outlets for discharging water from the tank for irrigation or other purposes. They may, however, be provided with arrangements for spilling away the surplus water that may enter the tank so as to avoid over-topping of the tank bund.

Under the “Jalatirtha” program, five Percolation Tanks have been constructed in Bankura in the blocks of Taldangra, Ranibundh, Saltora, Khatra and Onda.

8.1.5 **Re-Charge Pits**

Recharge pits are artificial recharge structures commonly used for recharging shallow phreatic aquifers, which are not in hydraulic connection with surface water due to the presence of impermeable layers. They do not necessarily penetrate or reach the unconfined aquifers. Recharge pits are normally excavated pits, which are sufficiently deep to penetrate the low-permeability layers overlying the unconfined aquifers. They are similar to recharge basins in principle, with the only difference being that they are deeper and have restricted bottom area.

In many such structures, most of the infiltration occurs laterally through the walls of the pit as in most layered sedimentary or alluvial material the lateral hydraulic conductivity is considerably higher than the vertical hydraulic conductivity. Abandoned gravel quarry pits or brick kiln quarry pits in alluvial areas and abandoned quarries in basaltic areas can also be used as recharge pits wherever they are underlain by permeable horizons.

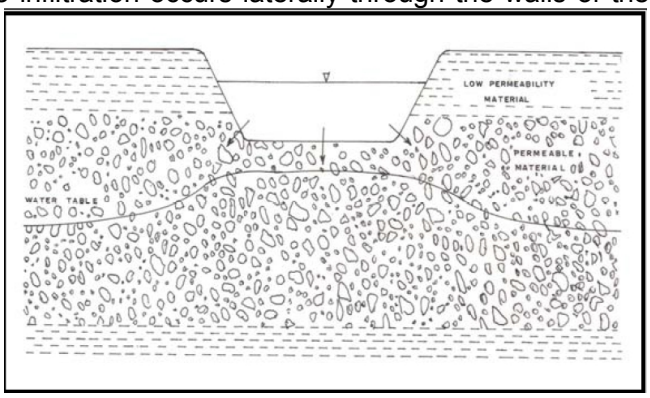


Figure 46: Schematic of Re-Charge Pit

8.1.6 **Re-Charge Wells**

Recharge wells are structures similar to bore/tube wells but constructed for augmenting the ground water storage in deeper aquifers through supply of water either under gravity or under pressure. The aquifer to be replenished is generally one with considerable de-saturation due to overexploitation of ground water.

In alluvial areas, wells recharging a single aquifer or multiple aquifers can be constructed in a manner similar to normal gravel packed pumping wells. However cement sealing of the upper section of the wells is done to prevent the injection pressure from causing leakage of water through the annular space of the borehole and the well assembly.

8.1.7 **Sub-surface Dykes**

A sub-surface dyke / ground water dam is a sub-surface barrier constructed across a stream channel for arresting/retarding the ground water flow and increase the ground water storage. At favorable locations, such dams can also be constructed not only across streams, but in large areas of the valley as well for conserving ground water.

CGWB has also recommended construction of Sub-surface dykes at specific intervals in the drainage channels of Kangsabati river, Silabati and Joypanda.

8.1.8 Initiatives undertaken by GoWB

8.1.8.1 Jalatirtha

The State Government has taken up an ambitious Scheme namely Jalatirtha under the Water Resources Development Directorate (WRDD) in 2014-15 in the arid zone of the State in the districts of Bankura, Birbhum, Purulia and Paschim Medinipur. The main objective of the scheme is to conserve surface water to provide round the year assured irrigation to the communities in the Scheme area by construction of Check Dams, Water Harvesting Structures and Surface Flow Minor Irrigation Schemes.

Apart from irrigation, the Scheme will is also intended to help in preventing soil erosion and recharge ground water aquifers to protect the environment apart from improving production and productivity of the agriculture and will also help in taking up allied activities like fishery, duckery and animal feeding etc.

Around 800 structures like Check Dams (CD), Water Harvesting Tank/ Structures (WHT) and Surface Flow Minor Irrigation Schemes (SFMIS) are proposed to be constructed under Jalatirtha, primarily for irrigation and improve agricultural productivity.

8.1.8.2 Jal Dharo-Jal Bharo

In order to combat the alarming situation in respect of both Ground and Surface water scenario in the state, “Jal Dharo-Jal Bharo" program was launched during 2011-12 for preservation of precious water resources. The Water Resources Investigation & Development Department and GoWB has taken the important role for large scale harvesting of rain water as well as arresting surface runoff for improvement and availability of precious water resources through construction and management of Minor Irrigation structures.

The objective of the "Jal Dharo-Jal Bharo" programme is to harvest rain water in all kinds of water bodies viz, tanks, ponds, reservoirs, canals and underground artificial recharge through rooftop rain water harvesting. For conservation and storage, rain water/surface run-off is arrested in derelict/silted tanks after proper de-siltation mainly for irrigation purposes.

The Department of Water Resources Investigation & Development is not only executing water harvesting structures under different plan fund but is also engaged in re-excavation of tanks and other water bodies under MGNREGA programme in convergence with P&RD Department, Govt of West Bengal. Different types of structures like Check Dams, Water harvesting Tanks and Surface Flow Minor Irrigation Schemes are being constructed for arresting surface run-off vis-a-vis utilisation of stored water for irrigation/other purpose.

8.1.9 Activities undertaken by PHED

Comprehensive ground water prospects map are available with the PHED, developed by Geo-informatics & Remote sensing cell, sponsored under Rajiv Gandhi National Drinking Water Mission, Department of Drinking Water Supply (DDWS) and available at http://www.wbphed.gov.in/main/index.php/achievements/14-organization/125-hydrogeology.

Primarily the Re-Charge structures recommended are Check Dams and Re-Charge Wells. On a case to case basis, recharge pits and De-Silting of tanks are also suggested.

8.2 Demand Managementand Strategies

Water Demand Management relies on a range of measures (tools and techniques) which can be divided into:

(a) Operational Measures
(b) Socio-political Measures and
(c) Economic Measures

The various adoptive strategies for Water Demand Management shall depend on:

- Increasing System Efficiency
- Increasing End Usage Efficiency and
- Providing for Distributed sources of Supply

We look at the various likely measures that could be adopted under the present scenario for the district of Bankura.

8.2.1 Operational Measures

The Operational measures of Demand management that can be undertaken to achieve better control and meet the demand management, may involve:

- Active Leakage Detection and repair through Pressure and Flow monitoring
- Recycling of Filter Backwash and Re-use
- Water metering and or flow regulating / restricting devices for water rationing (through Orifices) for equitable supply

The NRDWP guidelines as part of mandatory requirements has indicated the need for SCADA (Supervisory Control and Data Acquisition) as part of the provisions to be considered for all Schemes to minimize water losses for mega Schemes of value more than 20 Crores. It maybe clarified that the emphasis was to have a comprehensive data acquisition and monitoring system (Flow and Pressure monitoring) which will allow to assess leakage losses.

As a part of the mandate, the NRDWP also places clear guidelines on the need for recycling / re-use of filter-bed washed water. Such, provisions are to be integrated for all Surface water Bulk Water Schemes so as to increase the available water and meet additional demand.

The relevance of water metering including flow regulating / restricting devices are a part of the efforts to monitor and regulate water consumption. All such measures add cost to the system and require careful understanding. Prevailing Water Supply system designs have been operative on Stand-post basis for the communities, and as such the need for metering never made economic sense. However, water metering can be exercised at a village / habitation level or even on commercial / institutional usage (Schools, Government Offices) etc depending on situation to situation.

8.2.2 Socio-Political Measures

The Socio-political means of demand management can be categorized as:

- Policies and Guidelines of the Centre / State Government to specify standards on Service level norms
- Effective Public / Stakeholder Awareness in reducing water wastage
- Judicious usage of Water Use restrictions during periods of water shortages.

In so far as the policies are concerned, the basic minimum service level of potabledrinking water supply service in rural areas (In India) that was adhered to since the inception under ARWSP (Accelerated Rural Water Supply Program) was 40 lpcd.

The vision in the larger context under 12th five year plan is to cover all rural households @ 70 Lpcd.

An interim measure of 55 Lpcd has been considering in due cognizance that planning from 40 Lpcd to 70 Lpcd would require sizeable investment and infrastructural changeover. The NRDWP's goal is however set for a per capita supply of 70 Lpcd. This however does not limit the Individual State to adopt for a higher per Capita Supply rate (of 100 Lpcd). VISION 2020 for West Bengal emphasizes on a Per Capita Supply level of 70 Lpcd for design of system components. This consideration is based on the availability of water and has been the basis for designing system components in all the districts and is expected to remain the same.

The proposition of Tariff has been suggested under the NRDWP guidelines. The Tariff collection from every household and management of water supply scheme at the Gram Panchayet (GP) level shall be carried out by the Village and Water Sanitation Committee, (VWSC). The Public / Stakeholder Awareness to carry out awareness activities on water related issues are to be conducted by the VWSC.

8.2.3 Economic Measures

Economic techniques may depend on Incentives such as rebates, tax credits to allow for higher consumption and Disincentives such as real costs, penalties etc.

Based on the operational costs, there must be provisions thought of to define adequate means to cover the recurring costs of operating and maintain the system. Water subsidy maybe an option, but there must be logical justification to support the subsidy in case the consumptions / usage are more.

A higher cost of water (Above Rs 10 per Kl) would be difficult to manage politically. It is clear that economic measures have co-linkages with social and political ramifications. The NRDWP guidelines advise the implementation of a water tariff plan to balance the issues. A decision on the appropriate tariff requires further participatory stakeholder consultation and engagement to arrive at a definitive way forward.

Chapter 9 Water Quality Action Plan

The Uniform Drinking Water Quality Monitoring Protocol, published by the MDWS, advocates the need for improved monitoring and surveillance through effective Water Quality Testing, Mapping and Information Sharing, with emphasis on the WHO Guidelines for Drinking Water Quality, which state that "*The most effective means of consistently ensuring the safety of a drinking-water supply is through the use of a comprehensive risk assessment and risk management approach that encompasses all steps in water supply from catchment to consumer*".

Such approaches have been defined as the Water Safety Plan (WSP). The WSP is a comprehensive approach to consistently ensure the safety and acceptability of drinking water supply on a sustainable basis. More importantly, it allows for preventive / proactive approaches to minimize / eliminate perceived risks due to water contamination.

Whereas, it is beyond doubt that the WSSO Unit has performed exceedingly well in terms of Water Quality Monitoring and Surveillance including GIS based Mapping, it is felt that there is a need to address the various associated perceived risks in terms of drinking water supply system that could be effectively reduce / minimize contamination of the raw water sources.

It must be appreciated that most of the rural habitationspresently depend on ground water for their daily needs. The PHED, in their outlined Plans and Schemes, have looked into various options of Surface / Sub-Surface / Ground Water abstraction for providing piped water to the uncovered areas in Bankura district affected by fluoride contamination.

A Water Quality Action Plan is required to address relevant issues both on a short term basis and on a long term sustainable basis. The overarching goal however for the Water Quality Action Plan is to have safe and sustainable surface / sub-surface / ground water based piped water supply schemes as the permanent solution.

9.1 Participatory Planning and Source Sustainability

One of the key issues of the Water Quality Action plan relates to water security and as such participatory planning based on source sustainability. Based on the available data/ information, it is quite clear, that apart from the issues of ground water quality (Risks due to Fluoride contamination and high concentration of iron, requiring appropriate treatment) poor ground water potential and availability in select blocks is a serious issue, which is more likely justification to look for the more reliable surface water source as an alternative.

However, with the construction of dams along the major rivers, surface based supply has to depend on conveyance of raw water from these source points, which is costly. As such there is a need for appropriate evaluation of the blocks based on:

1. Available ground water potential and contamination including effective treatment and viability.
2. Surface / Sub-surface water availability including viability.

Based on the preliminary estimates, the raw water abstraction for Bankura district (Rural and 3 Urban Municipalities) is estimated at nearly 410 Mld. As such, a balance needs to be ensured between surface / sub-surface water to be tapped and ground water to be abstracted, based on viability, economic costs.

Under BRGF, Phase-I, 248.4 Mld of Water is proposed to be abstracted with approximately 101Mld of water is tapped from Durgapur barrage (74 Mld) and Kangsabati dam (27 Mld), 104 Mld from Sub-surface sources and around 41 Mld from

ground water sources. Criticality and Water quality issues are a concern for the blocks which have poor ground water potential, like Onda, Raipur and Simlapal.

For the proposed 8 blocks under present proposals, 148 Mld is proposed to be abstracted of which 79 Mld shall be from sub-surface abstraction, whereas the remaining 68 Mld shall be from Ground water.

The prospect of ground water abstraction from Indpur (16.2 Mld) and Taldangra (7.5 Mld) to meet the requirements are of serious concern since, ground water potential is poor (As per CGWB report). However, the information need to be validated with geo-physical investigations, and alternative options need to be explored.

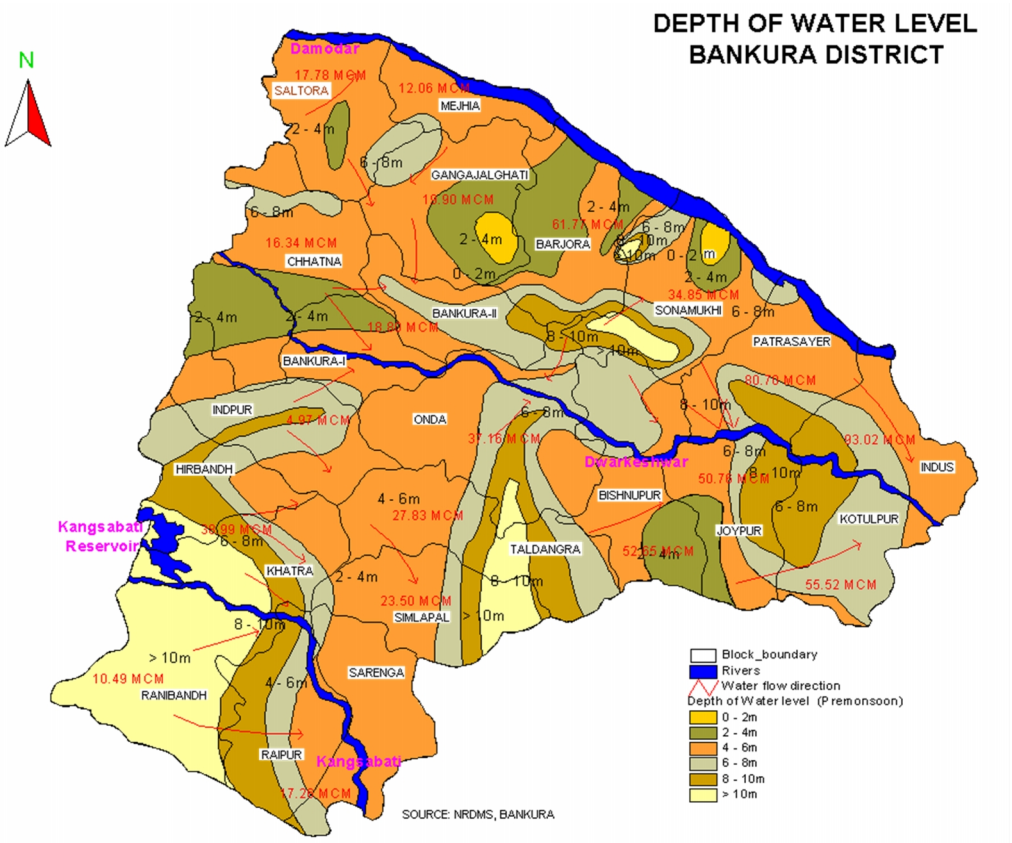


Figure 47: Ground water availability and Water Depth Level

For the blocks of Mejhia and Gangajalghati, the potential of withdrawal of surface water from Durgapur barrage maybe evaluated vis-à-vis sub-surface water from upstream of Damodar river. The sustainability and economic costs in the available options may-be taken up based on Hydro-geological investigations and River data from Irrigation Department.

For the blocks of Joypur, Kotulpur, where ground water availability and potential is high (With reduced risks of fluoride contamination), exploring ground water through tube wells is justified (based on ground water potential). However, used of river bed tube wells on the Dwarkeshwar to tap sub-surface water may also be reasonably explored as has been proposed, to allow for conjunctive usage. Similarly, for the blocks of Sonamukhi and Patrasayer, sub-surface water from Damodar (and Dwarkeshwar) maybe explored, along with ground water based on hydro-geological investigations.

The need for a comprehensive Integrated water resource management system involving water availability from the different sources to meet the demand requirement (of drinking water and agricultural usage) of the blocks should be primary aim justifying the participatory planning process, to develop a sustainable water balance at the district level.

9.2 Water Quality Management

9.2.1 Existing Water Quality Monitoring and Surveillance System

The Department of Drinking Water and Sanitation had identified Water Quality Management as one of the Key Strategic Objectives to meets its goal of adequate and safe drinking water for every rural person. The basic premise of Water Quality Management was outlined on 4 fundamentals approaches:

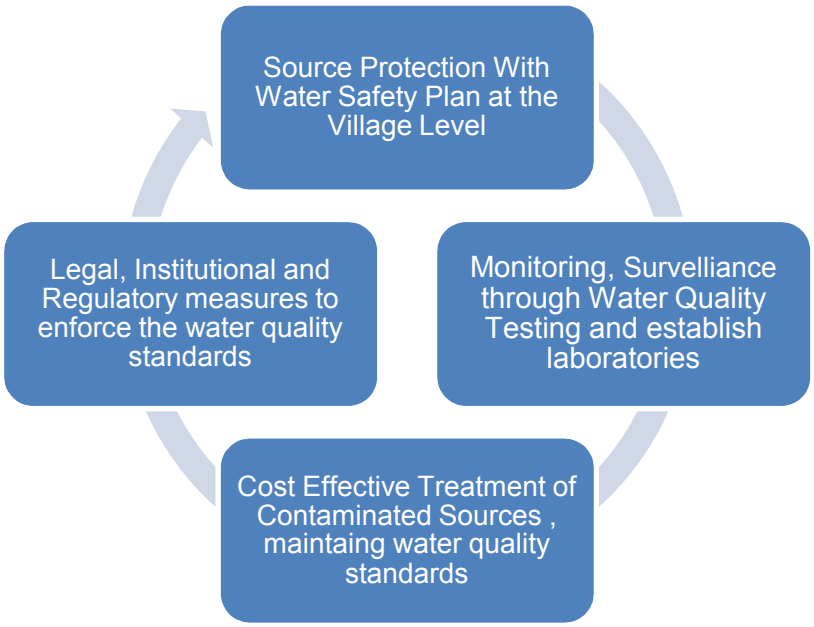


Figure 48: Approach to Water Quality Management

The Water and Sanitation Support Organization (WSSO) was thus formed within the PHE Department, GoWB to propagate and fulfill the overarching objectives of National Rural Drinking Water Programme. An Outline of the prevailing Water Quality Monitoring and Surveillance system is presented below.

9.2.1.1 Water Quality Monitoring Setup under PHED

The PHE Department, GoWB maintains 137 Laboratories across the State and liaisons with another 81 Laboratories managed by Non Governmental Organizations (NGO's) for performing water quality tests periodically, and maintain a comprehensive record of water quality across the various district.

Table 9-1: Water Testing Laboratories for WQM

Sl. No	District	Laboratories Managed By:		
		PHED	NGO	Total
1	Bankura	11	5	16
2	Barddhaman	13	6	19
3	Birbhum	6	4	10
4	Coochbehar	4	3	7
5	Dakshin Dinajpur	3	2	5
6	Darjeeling	4	1	5
7	Hooghly	4	5	9
8	Howrah	2	3	5
9	Jalpaiguri	4	3	7
10	Maldah	6	3	9

Sl. No	District	Laboratories Managed By:		
		PHED	NGO	Total
11	Murshidabad	13	7	20
12	Nadia	6	5	11
13	North 24 Parganas	11	7	18
14	Pashim Medinipur	14	7	21
15	Purba Medinipur	9	7	16
16	Purulia	13	4	17
17	South 24 Parganas	11	7	18
18	Uttar Dinajpur	3	2	5
Total		137	81	218

The Laboratories have been classified as General Laboratories, Arsenic Laboratories, Fluoride Laboratories, and Salinity Laboratories depending on water quality and the required type of tests required to be carried out, considering that select districts have ground water contaminated with Arsenic,Fluoride and Salinity.

9.2.1.2 Water Quality testing laboratories in Bankura

Of the 16 Laboratories in Bankura, 11 are managed by PHED, whereas another 5 Laboratories are managed by NGOs. The details of the Laboratories with Bankura are presented below:

Table 9-2: List of Laboratories in Bankura District

Sl. No:	Laboratory Name	Managed By	Situated at
1	Bankura District Lab Lokpur	PHED	Bankura Town
2	Bishnupur Sub-Division PHE Dte	PHED	Bishnupur
3	Gangajal Ghati Scheme	PHED	Gangajalghati
4	Mukutmanipur WTP Site	PHED	Khatra
5	Onda Scheme	PHED	Onda
6	Patrasayar Lab	PHED	Patrasayer
7	Raipur Scheme	PHED	Raipur
8	Saltora Scheme	PHED	Saltora
9	Sanadandha w/s Scheme	PHED	Bankura-I
10	Sarberia Scheme	PHED	Chhatna
11	Taldangra Scheme	PHED	Taldangra
12	Brajarajpur Tentulia Mahila & SIshu Kalyan Samity	NGO	Indpur
13	Chhoto Sarenga Co-Operative Labour Contract & Cons	NGO	Sarenga
14	Hijaldaha Vivekananda Seva Samity	NGO	Joypur
15	Mallabhum Mahila Kalyan Samity	NGO	Bankura-II
16	Sonamukhi Bikalpa Unayan Samity	NGO	Sonamukhi

9.2.2 Key Issues

Water Quality Testing and validation: The primary concern for water quality testing is the selection of parameters to be tested for raw water. Concerns related to ground water contamination are largely unnoticed in comparison to surface water sources, where laboratories do carry more regular checks. However with growing concerns on use of pesticide, increased level of contamination of surface as well as ground water, setting up specific testing parameters for each laboratory is essential. It is important to ensure that all laboratories are equipped appropriately to detect contaminants and are certified under the NABL scheme. Aframe-work for testing select contaminants at periodical intervals coupled with assessment of other potential contaminants is also required.

The other water quality issue that is of concern is confirmation / validation of a newly identified contaminated (Whether with Fluoride or any other contaminant) in the water source that is tested. It may-be acknowledged that errors in water quality analysis are although rarity cannot be denied. Case in point is the water quality results showing [26]arsenic contamination in Bankura. As such a system of checks and balance to confirm / validate newly identified contaminant needs to be re-checked and validated, prior to confirmation.

Establishing New Laboratories: One of the key issues related to the water quality monitoring is the adequacy of the laboratories in handling water quality tests. It may be acknowledged that the both the water quality monitoring and surveillance program as well as establishment of laboratories would depend on source that is being used for supply. As such, the water quality testing regime for Surface / Sub-surface based Schemes and Ground water based Schemes is expected to be different including water quality parameters.

In this background, it may-be reasonable re-look whether the laboratories in select blocks (like Indpur, Taldangra), which are affected by Fluoride contamination and have multiple Schemes based on ground water (more than 10 WS Schemes) are adequately resourced and staffed to handle the water quality tests on a regular basis. Similarly, Simlipal block, which is severely affected by Fluoride contamination, does not have water quality testing laboratory. Water quality surveillance can be effectively monitored only with testing laboratories in close proximity. As such the disposition of the laboratories needs to be adapted based on the source being tapped to allow for improved monitoring.

Cost Effective means of Treatment: Meeting water quality targets for surface based sources is not a critical issue for conventional WTPs treating surface water. Also, the cost of treating water on a large scale is usually cheaper. However, for treatment of ground water, packaged type Fluoride / Iron removal plants are used. It is realized that Pressure Type Iron removal plants have been used in Bankura, to remove the high concentration of Iron and the water in then supplied to the habitations. However, their effectiveness in treating ground water contaminated with (high levels of) Iron (As well as other contaminants) have to assessed on a long term to evaluate the performance. Also, the appropriateness of periodic backwashing and checks to assess clogging of filters including inspection are essential parts of the evaluating the Pressure type Iron removal plants. The PHED has already taken an initiative to evaluate Arsenic and Iron removal Plants for Ground water based Schemes. The same may be extended for ground water based Schemes for more comprehensive assessment.For Isolates habitations, it would be more meaningful in select cases to actually operate a Fluoride / Iron removal plant and serve locally.

Sanitary Management and Surveillance: Since existing water resources are spread out within the Blocks, it is important to assess current sanitation practices and ensure that proper hygienic sanitation management is implemented.

Specific actions for making the habitations and villages open defecation free (ODF) may be required, including ensuring proper solid and liquid disposal waste management system, where not already in place.

[26]As per IMIS data, Arsenic contamination has been found in Bankura

9.3 Sustainable Service Delivery

Sustainable service delivery requires improved monitoring, reduced operational and maintenance costs including service reliability. For Surface water sources, the onus will be the PHED to maintain the Bulk Water Supply Scheme; while for the ground water based Scheme will be operated and maintained by the rural communities (Village Water and Sanitation Committees).

9.3.1 Providing Household level Service Connection

Prevailing practice at habitation level results in water wastage and reduced serviceability. A household level service connection would imply ownership with the service connection and improved service reliability, with participatory involvement and linked to an appropriate tariff. Local communities, through VWSCs or similar, will be able to utilize district metering in order to manage their own distribution systems and minimise system losses.

9.3.1 24x7 Pressurized Water Supply System

The benefits of a continuous pressurised system for water supply are well known. Most of the habitations to be serviced are located far from their water sources / treatment plants. The clear water will be pumped to local storage reservoirs, usually overhead reservoirs (OHRs), from where village level supply is distributed.

A SCADA system can be utilised to monitor and/or control both the bulk water supply and the local distribution network. The bulk water supplier can then identify loss of pressure and other data which enables leakage points to be located as well as allowing remote control of pumping and reservoir storage levels.

Storage reservoirs can be fitted with water auto-level controllersto provide information for control of upstream pumping. Distribution networks should be formed into district metering areas (DMAs) to allow for monitoring of loss of pressure and leakage. The costs of flow/pressure loggers and or transmitters are usually nominal compared to the costs saved by minimizing/reducing water wastage and water loss. Through careful monitoring of the complete water supply network it is possible to operate and maintain a successful 24x7 water supply system.

9.3.2 Surface water grid

One of means to improve service reliability is to have grid network between adjoining blocks to allow for interdependency of water conveyance. The possibility of the Water Supply grid is a possible option that could be considered for the Surface / Sub-surface water based Schemes. In order to have grid, it is more appropriate that the blocks are in close proximity. Based on the existing locations of the blocks, the water source being tapped, following possible options for creation of grid can be explored within the district.

Table 9-3: Possible Options for Pipeline grid

Sl. No	Name of Blocks	Source Type / Source	Remarks	Grid
1	Mejhia-Gangahalghati	Sub-surface (Damodar)	Proposed	1
2	Saltora-Chhatna	Sub-surface (Damodar)	Implementation under progress	
3	Bankura-I, Bankura-II and Barjora	Surface (Durgapur barrage)	Implementation under progress	
4	Hirbandh-Khatra-Ranibandh	Surface (Kangsabati Dam)	Implementation under progress	2
5	Indpur-Taldangra	Surface (Kangsabati Dam)	Suggested to be Explored	

Sl. No	Name of Blocks	Source Type / Source	Remarks	Grid
6	Simplapal, Sarenga, Raipur	Ground water and Sub-Surface water	Implementation under progress	

However, the implementation issues related to additional pipeline for conveyance, pumping costs, operational and maintenance issues including associated costs are to be looked into prior to finalizing such a grid.

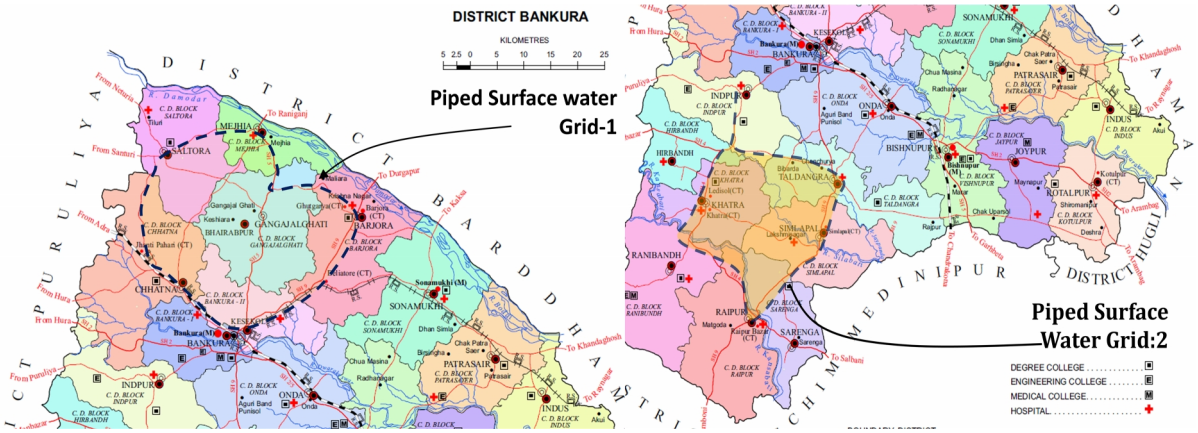


Figure 49: Piped Water Supply Grid: Suggestive Options

9.4 Conclusion and Way Forward

The Water Quality Action Plan is a guideline for implementation of the necessary activities required to ensure sustainable and uncontaminated water supplies are available to all the communities within the Bankura District and ensure that the objectives as enshrined in “VISION 2020” are achieved.

Some of the select action areas that are deemed necessary under the backdrop of the District Water Quality Action Plan are discussed below:

Table 9-4: Water Quality Action Plan

Sl. No	Activity / Component	Objective	Action Plan
1	Proposals for the remaining 8 Blocks related to selection of source sustainability	Determine options for sustainable water supplies to each block.	– Hydro-geological, Geo-physical investigations including hydrological studies to ensure source sustainability. – Feasibility studies to evaluate alternatives, and suggest best possible option. – Develop a Comprehensive Water balance for Bankura based on water abstraction.
2	Water Quality Monitoring with Laboratories	To ensure consistent and reliable testing facilities	Framework for Water Quality Testing and Testing regimen for: – Surface / Sub-Surface based sources – Ground water based sources Determine extent to which laboratories are NABL accredited and

Sl. No	Activity / Component	Objective	Action Plan
			take necessary steps to improve reliability
3	Sustainable Service Delivery	Potable drinking water to be provided in sufficient quantity and as per desired quality, equitably.	Provision for household level service connections to ensure, comprehensive coverage. Design considerations for 24x7 supply system. Increase service reliability with provision of piped water grid.
4	Assessment of existing and ongoing water supply schemes in Bankura District	Determine extent of contamination, availability of sustainable quantity of quality water	Suggest revisions to existing/ongoing schemes if necessary for contamination or resource reasons.Consider integration into other surface water fed schemes
5	Develop water supply schemes for areas not covered by existing designs	Ensure that the whole of Bankura District is covered with sustainable piped water supply systems by 2022	Assess water source sustainability on long term basis. Existing groundwater and surface water data to supplement by survey if needed. Check proposed sources are contamination free. Undertake necessary topographic survey. Design appropriate networks.
6	Check all schemes meet social and environmental safeguards criteria	Enable schemes to be appropriate for international funding and will be socially sustainable	Undertake socio-economic and environmental surveys of habitations. Conduct stakeholder Consultations Undertake willingness to pay surveys or assess alternative funding mechanisms
7	Check schemes comply with GOI and WBG norms	Ensure that schemes may proceed without undue process delay	PHED and others to check compliance with all norms.
8	Development Operation and Maintenance Plan	Ensure sustainability of project	Meet with relevant institutions and other stakeholders to determine responsibility and accountability for O&M
9	Prepare financial and economic assessment of proposed schemes	Ensure schemes are viable and affordable on a sustainable basis	Analyze existing institutional and financial models and suggest appropriate models for West Bengal
10	Prepare detailed designs and bid documents for proposed schemes	Invite competent Contractors to bid for scheme construction	Recruit design consultants, as necessary
11	Construct and commission proposed	Implementation of schemes to provide safe and sustainable	Selection of contractors and supervision consultants.

Sl. No	Activity / Component	Objective	Action Plan
	schemes	water supply to benefit communities throughout Bankura District	

This Water Quality Action Plan is intended to be a living document requiring updating and amendment from time to time. It contains a summary of the extensive available data on the existing and proposed water supply schemes for West Bengal and provides essential background information which may be used as guidance during the preparation of feasibility studies for proposed water supply schemes within the Bankura District. It should be regarded as a useful reference work and not a definitive document when assessing the requirements for long term sustainable solutions.

The various activities referred to in this draft Action Plan, including comprehensive studies and investigations, will be taken up in due course with participative institutions in preparation of Feasibility Reports and subsequent Detail Designs.

Timely implementation of these activities will help considerably towards achieving the aims of the VISION 2020.

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Annexure-1: Arsenic and Fluoride affected Habitations as per IMIS-MoDWS (Across India, as on 18/08/2016) Not covered by Piped Water Supply

Table 1: Arsenic affected Habitations as per IMIS-MoDWS

Sl. No.	State	Total Habitation	Total Population	Habitations Affected	Affected population in such habitations	% of Arsenic affected Population in State / India
1	Andaman and Nicobar	400	264870	0	0	0.0%
2	Andhra Pradesh	48342	36632785	0	0	0.0%
3	Arunachal Pradesh	7577	1250535	343	22479	0.2%
4	Assam	88099	29658323	3726	1236964	9.6%
5	Bihar	110234	99454050	1077	1666039	12.9%
6	Chandigarh	18	100183	0	0	0.0%
7	Chattisgarh	74647	19795446	0	0	0.0%
8	Dadra & Nagar Haveli	70	216227	0	0	0.0%
9	Daman & Diu	21	83567	0	0	0.0%
10	Goa	347	730923	0	0	0.0%
11	Gujarat	36066	37117600	0	0	0.0%
12	Haryana	7948	18407573	45	142944	1.1%
13	Himachal Pradesh	53604	6686071	0	0	0.0%
14	Jammu and Kashmir	15958	10216956	7	3642	0.0%
15	Jharkhand	120067	26899888	130	115862	0.9%
16	Karnataka	60248	40277798	21	47141	0.4%
17	Kerala	11883	26874598	3	7651	0.1%
18	Lakshadweep	9	51472	0	0	0.0%
19	Madhya Pradesh	128067	52813783	0	0	0.0%
20	Maharashtra	100066	64445038	1	87	0.0%
21	Manipur	2868	2329245	0	0	0.0%
22	Meghalaya	10475	2667743	1	169	0.0%
23	Mizoram	738	523137	0	0	0.0%
24	Nagaland	1530	1726992	0	0	0.0%
25	Odisha	156468	35652623	2	42	0.0%
26	Puducherry	266	438075	0	0	0.0%
27	Punjab	15384	17989668	492	590103	4.6%
28	Rajasthan	121648	50806731	3	0	0.0%
29	Sikkim	2084	458838	0	0	0.0%
30	Tamil Nadu	100204	39617768	0	0	0.0%
31	Telangana	24582	22738920	0	0	0.0%
32	Tripura	8723	4491866	1	1118	0.0%
33	Uttar Pradesh	260801	168768908	262	159572	1.2%
34	Uttarakhand	39209	7200799	0	0	0.0%
35	West Bengal	105905	74637222	8066	8950460	69.1%
Total		1714556	902026221	14180	12944273	100.0%

Table 2: Fluoride affected Habitations as per IMIS-MoDWS

Sl. No.	State	Total Habitation	Total Population	Habitations Affected	Affected population in such habitations	% of Total affected Population
1	Andaman and Nicobar	400	264870	0	0	0.0%
2	Andhra Pradesh	48342	36632785	421	292899	3.4%
3	Arunachal Pradesh	7577	1250535	0	0	0.0%
4	Assam	88099	29658323	155	19729	0.2%
5	Bihar	110234	99454050	1043	1128975	13.3%
6	Chandigarh	18	100183	0	0	0.0%
7	Chattisgarh	74647	19795446	75	24484	0.3%
8	Dadra & Nagar Haveli	70	216227	0	0	0.0%
9	Daman & Diu	21	83567	0	0	0.0%
10	Goa	347	730923	0	0	0.0%
11	Gujarat	36066	37117600	11	19077	0.2%
12	Haryana	7948	18407573	200	487889	5.7%
13	Himachal Pradesh	53604	6686071	0	0	0.0%
14	Jammu and Kashmir	15958	10216956	0	0	0.0%
15	Jharkhand	120067	26899888	998	482050	5.7%
16	Karnataka	60248	40277798	1038	479224	5.6%
17	Kerala	11883	26874598	73	91996	1.1%
18	Lakshadweep	9	51472	0	0	0.0%
19	Madhya Pradesh	128067	52813783	136	5519	0.1%
20	Maharashtra	100066	64445038	100	112297	1.3%
21	Manipur	2868	2329245	0	0	0.0%
22	Meghalaya	10475	2667743	0	0	0.0%
23	Mizoram	738	523137	0	0	0.0%
24	Nagaland	1530	1726992	0	0	0.0%
25	Odisha	156468	35652623	65	21609	0.3%
26	Puducherry	266	438075	0	0	0.0%
27	Punjab	15384	17989668	285	335296	3.9%
28	Rajasthan	121648	50806731	6849	2985305	35.1%
29	Sikkim	2084	458838	0	0	0.0%
30	Tamil Nadu	100204	39617768	0	0	0.0%
31	Telangana	24582	22738920	1041	1299331	15.3%
32	Tripura	8723	4491866	0	0	0.0%
33	Uttar Pradesh	260801	168768908	200	204445	2.4%
34	Uttarakhand	39209	7200799	0	0	0.0%
35	West Bengal	105905	74637222	1046	517509	6.1%
Total		1714556	902026221	13736	8507634	100.0%

Annexure-2: Overall Arsenic and Fluoride affected Habitations as per IMIS in West Bengal, (As on 18/08/2016)

Table 1: Arsenic affected Habitations

Sl. No	District	Total Habitation	Total Population	Affected Habitation	Affected Population	% of Affected Population
1	North 24 Parganas	7334	5184365	2699	2196158	42.4%
2	Nadia	3944	4248441	2448	3030716	71.3%
3	Murshidabad	3105	6790427	1439	3895605	57.4%
4	Maldah	7787	5717269	836	1156620	20.2%
5	Bardhaman	5386	5271056	142	291224	5.5%
6	South 24 Parganas	9039	7405677	322	252114	3.4%
7	Hooghly	11762	3975186	178	98050	2.5%
8	Howrah	2130	3116331	1	2876	0.1%
9	Bankura	6638	3403362	1	3115	0.1%
Total		57125	45112114	8066	10926478	24.2%

Table 2: Fluoride affected Habitations

Sl. No	District	Total Habitation	Total Population	Affected Habitation	Affected population	% of Affected Population
1	Dakshin Dinajpur	4788	1480800	701	251917	17.0%
2	Purulia	4363	2802601	229	245900	8.8%
3	Birbhum	4335	3416742	51	55671	1.6%
4	Bankura	6638	3403362	43	30570	0.9%
5	Uttar Dinajpur	3687	2672341	18	28985	1.1%
6	Maldah	7787	5717269	4	2110	0.0%
Total		31598	19493115	1046	615153	3.2%

NOTE:

(1) As per the IMIS, only a small portion of the population affected by Arsenic and Fluoride contamination in West Bengal has been covered under Piped Water Supply Schemes.

(2) An estimated 8.95Million (Refer Annexure-01) people affected by Arsenic contamination out of 10.926 Million in West Bengal are still to be covered under piped water supply.

(3) Likewise an estimated 0.517 Million (Refer Annexure-01) people affected by Fluoride contamination out of 0.615 Million in West Bengal are still to be covered under piped water supply.

Annexure-3: Road Network in Bankura District

The National Highway 60 or NH-60 connects NH-5 (At Balasore) to NH-34 (At Morgram). Within Bankura, it runs through Bishnupur, Bankura, Gangajalghati and Mejia, an approximate distance of 93 Kms before crossing over to Ranigunj. State Highway-2, 4, 8 and 9 are the major State Highways connecting / interconnecting Bankura, with the rest of the districts. Details of the major [1]National / State Highways within the district and their connectivity as per available information are presented below:

Table 1: Details of Major Roads in Bankura

Sl. No:	National / State Highway Number	Length		Details of major Blocks through which passing:
		Total	In Bankura	
1	NH-60	446	93	Bishnupur, Onda, Bankura, Gangajalghati and Mejia
2	NH-60A	84	33	Bankura-II,Bankura-I
3	State Highway-2	323	117	Saltora, Chhatna, Bankura-II, Chhatna, Indpur to SH-4
4	State Highway-4	466	80	Hirbandh, Khatra to Sarenga
5	State Highway-7	289	-	Bishnupur, Joypur, Kotulpur
6	State Highway-8	292	112	Beliatore, Sonamukhi, Patrasayer and Indua
7	State Highway-9	251	82	Durgapur, Beliatore, Bankura, Onda, Taldangra, Simlapal, Sarenga, Raipur

The various statutory bodies responsible for overall maintenance of the roads is tabled below:

Table 2: Length of Roads maintained by various statutory bodies in Bankura

Sl. No:	Statutory Authority	Road		
		Surfaced	Un-Surfaced	Total
1	Public Works Department, - GoWB	1189.00	15.00	1204.00
2	Zilla Parishad	651.95	478.02	1129.97
3	Gram Panchayat	242.23	7629.00	7871.23
4	Pradhan Mantri Gram Sadak Yojna	830.20	0.00	830.2
Total		2913.38	8122.02	11035.4

Based on the significance, the details of [2]road connectivity in each block of Bankura to the various inhabited Villages are tabled below:

Table 3: Details of Road Connectivity to Inhabited Villages

Sl. Nos	Name of CD block	Inhabited villages	Connected by Road Network		Approach By Pucca Road	
1	0203-Saltora	145	55	37.93%	40	27.59%
2	0204-Mejhia	72	19	26.39%	18	25.00%
3	0205-Gangajalghati	156	34	21.79%	53	33.97%
4	0206-Chhatna	277	70	25.27%	93	33.57%
5	0207-Indpur	198	85	42.93%	60	30.30%

[1]http://www.pwdwb.in/road/state_highway
[2]District Census Handbook

Sl. Nos	Name of CD block	Inhabited villages	Connected by Road Network		Approach By Pucca Road	
6	0208-Bankura - I	137	50	36.50%	32	23.36%
7	0209-Bankura - II	144	48	33.33%	37	25.69%
8	0210-Barjora	182	75	41.21%	39	21.43%
9	0211-Sonamukhi	161	67	41.61%	54	33.54%
10	0212-Patrasayer	151	46	30.46%	48	31.79%
11	0213-Indus	129	66	51.16%	37	28.68%
12	0214-Kotulpur	165	66	40.00%	43	26.06%
13	0215-Joypur	137	77	56.20%	48	35.04%
14	0216-Vishnupur	147	68	46.26%	40	27.21%
15	0217-Onda	271	88	32.47%	51	18.82%
16	0218-Taldangra	141	61	43.26%	30	21.28%
17	0219-Simlapal	191	65	34.03%	62	32.46%
18	0220-Khatra	146	38	26.03%	55	37.67%
19	0221-Hirbandh	116	33	28.45%	41	35.34%
20	0222-Ranibundh	169	70	41.42%	53	31.36%
21	0223-Raipur	197	69	35.03%	59	29.95%
22	0224-Sarenga	153	51	33.33%	48	31.37%
	Total	**3585**	1301	36.29%	1041	29.04%

Annexure-04: River Water Quality Data

Table 1: River Water Quality- CPCB (2012)

Sl. No	River / River Location	pH			Dissolved Oxygen (In Mg/l)			B.O.D. (In mg/l)			Faecal Coliform (MPN/100 Ml)			Total Coliform (MPN/100 Ml)		
		Minm.	Maxm.	Mean	Minm.	Maxm.	Mean	Minm.	Maxm.	Mean	Minm.	Maxm.	Mean	Minm.	Maxm.	Mean
		6.5 – 8.5			> 4.0 Mg/l			< 3.0 Mg/l			< 2500 MPN/100 Ml			< 5000 MPN/100 Ml		
1	Damodar, At Narainpur after confluence of Nunia Nallah	7.0	8.2	7.7	5.5	10.2	7.9	1.8	6.3	3.2	200	14000	2083	700	90000	13150
2	Damodar, Near Mujher mana Village after confluence of Tamla Nallah	7.1	8.7	7.9	5.0	8.8	6.9	3.2	8.0	4.8	400	90000	16825	1700	200000	68808
3	Dwarkeshwar, Water intake point for Bankura Town on river	7.1	8.4	7.9	4.1	11.6	7.8	0.5	4.5	1.7	4	35000	3491	8	200000	52250
4	Silabati (D/s of Silabati at Ghatal)	7.0	7.9	7.5	5.1	8.6	6.9	0.9	3.4	2.1	2000	30000	11750	4000	50000	25083

Source: STATUS OF WATER QUALITY IN INDIA- 2012, Published by CPCB

Annexure-05: Profile Characteristics of River in Bankura

Papers and journals as available from Internet have been reviewed for the case specific section. Specific abstracts as found justified and applicable are presented herein. The specific papers from which these have been sourced are presented in separately for understanding.

In line with the studies specific definition

Based on the Sinuosity Index, the major rivers of Bankura has been classified and categorized as shown below:

Table 1: Classification of Rivers in Bankura in terms of Sinuosity Index

Sl. No.:	River	SI - Value	Type of Sinuosity	Nature of
1	Damodar	1.09	Weak	The river in the district shows a declining trend in SI. It gradually straightens its course during the time period. After the construction of the dam it lost its original character.
2	Sali	1.15	Weak	
3	Dwarekeshwar	1.33	Moderate	The river shows a moderate SI, which increases downstream.
4	Silabati	1.35	Moderate	The river is the most Sinuous.
5	Kangsabati	1.25	Moderate	The river shows a rising trend in SI.

Sinuosity Index

The Sinuosity Index of a river is a measure of deviation of the river from its ideal path of movement and is expressed as:

Sinuosity Index (SI) = CL / AL,

Where,

CL = Actual Channel Length between source and mouth
SL = Straight line length between the same points

Lateral Entrenchment Ratio (ER)

It is the ratio between lengths of the two banks of a river as expressed under:

Lateral Entrenchment Ratio (ER) = LL/LR

Where

LL= Length of the left bank and
LR= Length of the right bank

Lateral Entrenchment ratio helps to identify the amount of bank shifting of a river. If the value remains 1 it means there is no bank shifting. If it is greater than 1 that means channel has shifted towards its left bank and ER less than 1 means the channel has shifted towards the right bank at the given section of the river.

Based on available satellite data obtained for a 10 year period, it was observed that there was no change of lateral entrenchment ration of the Dwarakeswar, Silabati and Kangsabati. River Damodar showed a fluctuating left to right bank shifting. Sali river was exempted from the study because of the limitation of the satellite data available.

Change in Alignment of Rivers

Based on the study of Sinuosity Index and Lateral Entrenchment Ratio, a study carried independently with respect to remote sensing data and GIS (based on data over a 30 year period, from 1972 to 2001) found that the River Silabati has had the maximum shift followed by Dwarakeswar, Kangsabati and Sali river.

The average shifting of the Dwarekeshwar river is about 160 metres in the upper course. The middle and lower course of the river is most affected by shifting of about 415 metres.

The Sali river shifted about 218 metres. Among the seven reaches of the river that were identified, 5 reaches shifted towards the right i.e. southwards with an average of 200 metres while the two reaches 4 and 5 shifted towards left i.e. northwards. The average rate of shifting of the river during the study period is 7.5 metres per year.

The Silabati river appears to have shifted most in the district with an average shifting of about 519 metres. In the middle course the shifting is higher (731 m) than its lower course (360 m) within the district.

The shifting of the Kangsabati has been on an average of 5m-8m per annum. However, the lateral entrenchment ratio has remain unchanged during the period. The shifting occurs within the two banks and as the river banks are mostly composed of hard crystalline rocks these is not vulnerable for bank erosion.

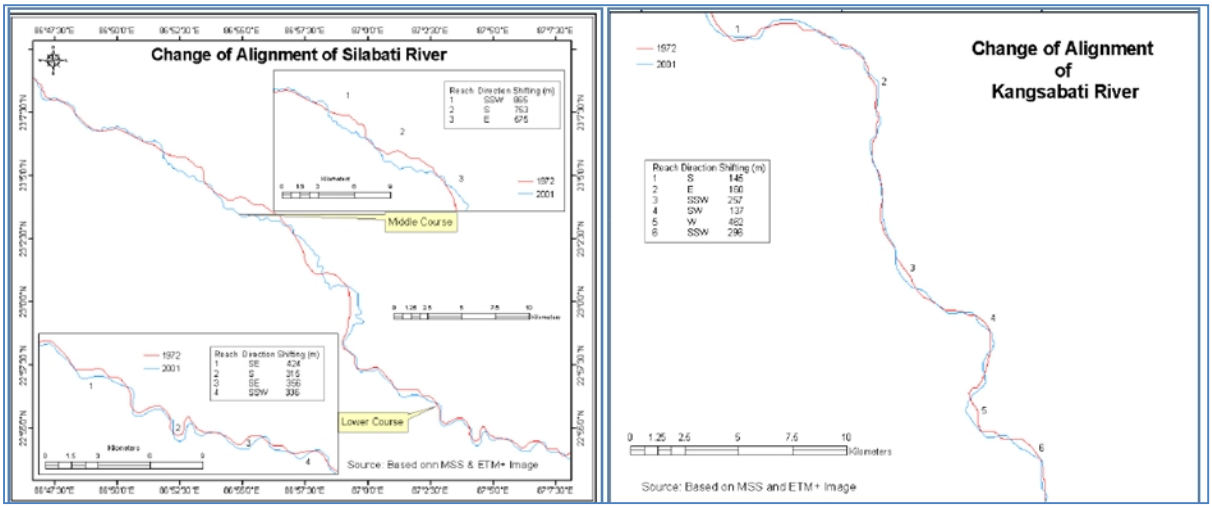

Figure 1: Change in Alignment of Silabati and Kangsab

Annexure- 06: Ground water potential in Blocks: CGWB

The ground water potential within the Community Development Blocks in Bankura as per the Ground Water Booklet of Central Ground Water Board is presented below:

Table 1: Ground Water Potential: As per CGWB

Sl. No	Block	Occurrence of aquifer B.G.L	Expected Yield	CGWB Recommendation as per GW Booklet
1	Mejhia	5m-15m	10 Cum/Hr	Area not feasible for ground water development.
2	Gangajalghati	5m-15m	10 Cum/Hr	Area not feasible for ground water development.
3	Indpur	5m-15m	10 Cum/Hr	Area not feasible for ground water development.
4	Joypur	64m -199m	60 – 150 Cum/Hr	The aquifers are potential and the block is under safe category. Ground water development maybe done in a safe manner.
5	Kotulpur	44m – 50m; 95m-124m	81 – 212 Cum/Hr	The aquifers are potential and the block is under safe category. Ground water development maybe done in a safe manner.
6	Patrasayer	30m-149m	32 – 138 Cum/Hr	The aquifers are potential and the block is under safe category. Ground water development maybe done in a safe manner.
7	Sonamukhi	34m-161m	100 – 220 Cum/Hr	The aquifers are potential and the block is under safe category. Ground water development maybe done in a safe manner.
8	Taldangra	45m – 75m	50 – 150 Cum/Hr	The aquifers over a small area in the Eastern part are potential for development. The western part of the block is covered by hard massive rock, and as such ground water development is not feasible.
9	Ranibundh	5m-15m	10 Cum/Hr	Ground water potential is limited and contaminated with Fluoride.
10	Hirbandh	5m-15m To Upto 50m	10 Cum/Hr	Sporadic Occurrence of High fluoride in ground water. Measures regarding De-fluoridation to be taken prior to use of ground water for drinking.
11	Khatra	5m-15m To Upto 50m	10 Cum/Hr	Area not feasible for ground water development. Development to be done scientific manner.
12	Chhatna	5m-15m To Upto 50m	10 Cum/Hr	Area not feasible for ground water development. Development to be done scientific manner.
13	Bankura-I	5m-15m To Upto 50m	10 Cum/Hr	Area not feasible for ground water development. Development to be done scientific manner.
14	Bankura-II	5m-15m To Upto 50m	10 Cum/Hr	Area not feasible for ground water development. Development to be done scientific manner. Fluoride

Sl. No	Block	Occurrence of aquifer B.G.L	Expected Yield	CGWB Recommendation as per GW Booklet
			15 – 30 /100 Cum/Hr	Contamination is reported. Measures to be taken before using ground water from drinking purposes.
15	Barjora	Upto 130m	150 Cum/Hr	The ground water has potential, although contaminated by Fluoride.
16	Indus	Aquifers at Multiple depths	90 – 160 Cum/Hr	The aquifer has potential and ground water development can be taken up.
17	Simmlapal	Aquifers at Multiple depths	90 – 160 Cum/Hr	Part of the area and along banks of Joypanda, auto-flow tube wells are feasible. Ground water is however contaminated by fluoride.
18	Onda	Aquifers at Multiple depths, Upto 120m	25 – 30 Cum/Hr	Ground water potential is limited.
19	Saltora	Upto 20m	10 – 15 Cum/Hr	Ground water potential is very limited.
20	Sarenga	Semi-confined conditions	10 – 20 Cum/Hr	Ground water potential is limited.
21	Bishnupur	Multiple depths	115 – 180 Cum/Hr	Aquifers in the area have potential (baring a small portion in the north) and area falls under safe category.
22	Raipur	5m-15m	10 Cum/Hr	Ground water contaminated with Fluoride. Measures to be taken prior to use of ground water for drinking
		Upto 130m (In Older Alluvium)	50 – 150 Cum/Hr	

In Blocks where excess fluoride concentration in ground water has been recorded, proper de-fluoridation technique has been recommended by the CGWB prior to use for drinking.

Based on the various recommendations of the CGWB, the overall ground water scenario within the Blocks varies from limited (10 Cum/Hr – 15 Cum/Hr) to good (>100Cum/Hr). In some Blocks, the ground water potential varies within the 2 extremes. Within the suggested guidelines and recommendations, a matrix for the various blocks with limited potential, mixed and medium to high potential is worked out to better assess overall the

Table 2: Ground Water Potential within C.D Blocks of Bankura

Sl. No	Ground Water Potential	Name of Blocks	Number of Blocks
1	Poor	Ranibundh, Hirbundh, Khatra, Indpur, Gangajalghati, Mejhia, Chhatna, Bankura-I & II, Onda, Saltora, Sarenga	12
2	Poor to medium	Taldangra, Joypur, Raipur, Patrasayer,	4
3	Medium to High	Sonamukhi, Indus, Kotulpur, Bishnupur, Simlapal, Barjora	6
		Total Number of Blocks	22

Drinking Water Quality Action Plan - Bankura
West Bengal Water Supply Improvement Investment Program

Pattern of Distribution of Fluoride in Groundwater in the Blocks of Bankura District **(2013-14)**

Sl. No.	Name of Blocks	Number of Samples Tested	Number of Habitation affected by F concentration > 1.5 (mg/l)	Samples with F > 1.5(mg/l)	Fluoride Concentration (In mg/l)			Number of Habitation affected by F concentration 1.0 - 1.5(mg/l)	Samples with Fluoride Conc. 1.0 - 1.5(mg/l)
					Minimum	Maximum	Mean		
1	Bankura I	464	1	1	-	2.04	2.04	5	11
2	Bankura II	624	4	4	1.66	3.95	2.46	9	12
3	Barjora	530	1	2	5.45	6.22	5.83	0	0
4	Bishnupur	898	0	0	-	-	-	1	1
5	Chhatna	1385	9	10	1.65	3.26	2.29	46	70
6	Ganjagalghati	1397	3	3	1.51	1.69	1.6	28	66
7	Hirabandh	350	0	0	-	-	-	0	0
8	Indpur	308	0	0	-	-	-		0
9	Indus	580	0	0	-	-	-	1	1
10	Jaypur	666	0	0	-	-	-	0	0
11	Khatra	323	1	1	-	6.95	6.95	2	2
12	Kotulpur	509	0	0	-	-	-	2	2
13	Mejia	242	2	2	1.67	3.22	2.44	9	22
14	Onda	1328	0	0	-	-	-	1	1
15	Patrasayer	348	0	0	-	-	-	0	0
16	Raipur	805	2	3	2.68	4.67	3.76	2	2
17	Ranibundh	575	0	0	-	-	-	1	1
18	Saltora	601	6	11	1.78	3.97	2.55	26	54
19	Sarenga	601	1	1	-	2.01	2.01	0	0
20	Simlipal	656	1	7	1.59	4.91	2.96	4	6
21	Sonamukhi	596	0	0	-	-	-	0	0
22	Taldangra	747	0	0	-	-	-	2	2
TOTAL		**14533**	**31**	**44**				**139**	**253**

Pattern of Distribution of Fluoride in Groundwater in the Blocks of Bankura District **(2014-15)**

Sl. No.	Name of Blocks	Number of Samples Tested	Number of Habitation affected by F concentration	Samples with F > 1.5(mg/l)	Fluoride Concentration (In mg/l)			Number of Habitation affected by F concentration 1.0 - 1.5(mg/l)	Samples with Fluoride Conc. 1.0 -
					Minimum	Maximum	Mean		
1	Bankura I	802	0	0	0	0	-	7	11
2	Bankura II	1365	13	19	1.55	5.1	7.1	22	36
3	Barjora	1688	10	14	1.52	5.86	2.01	20	35
4	Bishnupur	923	0	0	-	-	-		0
5	Chhatna	2809	26	36	1.55	8.12	2.2	51	68
6	Ganjagalghati	2522	15	21	1.55	2.32	1.88	54	146
7	Hirabandh	1056	10	10	1.54	10.8	3.41	41	53
8	Indpur	1714	5	5	1.62	7.09	3.67	27	36
9	Indus	861	0	0	-	-	-		0
10	Jaypur	769	0	0	-	-	-		0
11	Khatra	911	2	2	1.61	1.69	1.65		0
12	Kotulpur	818	0	0	-	-	-		0
13	Mejia	353	1	1	-	8.01	8.01	6	15
14	Onda	1445	1	1	-	6.75	6.75		0
15	Patrasayer	760	0	0	-	-	-		0
16	Raipur	1497	2	2	1.7	1.91	1.8	18	25
17	Ranibundh	908	0	0	-	-	-	4	5
18	Saltora	938	17	19	1.54	3.41	2.04	18	52
19	Sarenga	696	0	0	-	-	-		0
20	Simlipal	1293	90	154	1.51	2	1.87	46	55
21	Sonamukhi	681	0	0	-	-	-		0
22	Taldangra	1997	11	20	1.57	9.28	2.62	16	30
TOTAL		**26806**	**203**	**304**				**330**	**567**

Drinking Water Quality Action Plan - Bankura
West Bengal Water Supply Improvement Investment Program

Pattern of Distribution of Fluoride in Groundwater in the Blocks of Bankura District **(2015-16)**

Sl. No.	Name of Blocks	Number of Samples Tested	Number of Habitation affected by F concentration > 1.5 (mg/l)	Samples with F > 1.5(mg/l)	Fluoride Concentration (In mg/l)			Number of Habitation affected by F concentration 1.0 - 1.5(mg/l)	Samples with Fluoride Conc. 1.0 - 1.5(mg/l)
					Minimum	Maximum	Mean		
1	Bankura I	456	0	0	-		-	5	6
2	Bankura II	622	1	1	-	2.57	2.57	20	44
3	Barjora	459	2	2	1.82	4.4	3.11		0
4	Bishnupur	497	0	0	-		-	2	2
5	Chhatna	853	11	20	1.59	6.5	2.33	28	45
6	Ganjagalghati	1002	1	1	-	2.34	2.34	25	47
7	Hirabandh	194	0	0	-	-	-		0
8	Indpur	480	1	1	-	4.89	4.89		0
9	Indus	580	1	1	-	1.59	1.59	1	1
10	Jaypur	514	0	0	-	-	-		0
11	Khatra	505	2	3	1.8	3.76	2.65	2	2
12	Kotulpur	313	0	0	-	-	-		0
13	Mejia	228	1	1		1.83	1.83	8	24
14	Onda	475	0	0	-	-	-		0
15	Patrasayer	512	0	0	-	-	-		0
16	Raipur	66	0	0	-	-	-		0
17	Ranibundh	473	0	0	-	-	-		0
18	Saltora	341	8	13	1.6	2.5	1.95	10	20
19	Sarenga	69	1	1	-	6.66	6.66		0
20	Simlipal	54	1	1	-	6.23	6.23	3	3
21	Sonamukhi	351	1	1	-	9	9		0
22	Taldangra	337	1	1	-	2.11	2.11	1	1
TOTAL		**9381**	**32**	**47**				**105**	**195**

Pattern of Distribution of Fluoride in Groundwater in the Blocks of Bankura District **(2016-17)**

Sl. No.	Name of Blocks	Number of Samples Tested	Number of Habitation affected by F concentration > 1.5 (mg/l)	Samples with F > 1.5(mg/l)	Fluoride Concentration (In mg/l)			Number of Habitation affected by F concentration 1.0 - 1.5(mg/l)	Samples with Fluoride Conc. 1.0 - 1.5(mg/l)
					Minimum	Maximum	Mean		
1	Bankura I	132	1	1	-	4	4	1	1
2	Bankura II	46	1	1	-	2.75	2.75	2	3
3	Barjora	74	0	0	-	-	-		0
4	Bishnupur	50	0	0	-	-	-		0
5	Chhatna	203	1	1	-	1.96	1.96	12	15
6	Ganjagalghati	86	1	1	-	1.52	1.52		0
7	Hirabandh	84	0	0	-	-	-		0
8	Indpur	149	1	1		6.23	6.23		0
9	Indus	56	1	1		3.45	3.45		0
10	Jaypur	105	0	0	-	-	-		0
11	Khatra	103	0	0	-	-	-		0
12	Kotulpur	97	0	0	-	-	-		0
13	Mejia	44	0	0	-	-	-		0
14	Onda	130	0	0	-	-	-		0
15	Patrasayer	84	0	0	-	-	-		0
16	Raipur	94	1	6	1.51	2.23	1.9	2	2
17	Ranibundh	148	0	0	-	-	-		0
18	Saltora	89	0	0	-	-	-	5	5
19	Sarenga	59	0	0	-	-	-		0
20	Simlipal	146	3	5	1.69	2.09	1.8	4	4
21	Sonamukhi	76	0	0	-	-	-		0
22	Taldangra	59	0	0	-	-	-		0
TOTAL		**2114**	**10**	**17**				**26**	**30**

Drinking Water Quality Action Plan - Bankura
West Bengal Water Supply Improvement Investment Program

Water Quality Results (PHED)

Sl	District	Block	Panchayat	Village	JL no.	Habitation	Maximum Fluoride Concentration (mg/lt)	Population
1	BANKURA	BANKURA-I	ANCHURI	KERANIPUR	162	KARANIPUR	1.62	36
2	BANKURA	BANKURA-I	ANDARTHOLE	ANDHARTHAUL	134	ANDHARTHOLE	1.62	2177
3	BANKURA	BANKURA-I	ANDARTHOLE	CHHATAR DIHI	164	NARANDIHI	4.15	124
4	BANKURA	BANKURA-I	JAGADALLA-II	MANUSHMURA	188	MANUSMURA	1.71	1088
5	BANKURA	BANKURA-I	KALPATHAR	BANCHINGRA	118	BANCHINGRA	2.04	540
6	BANKURA	BANKURA-II	BIKNA	BIKNA	235	BIKNA	2.57	2638
7	BANKURA	BANKURA-II	BIKNA	KADMAGHATI	252	KADAMGHATI	1.5	797
8	BANKURA	BANKURA-II	BIKNA	MITHILA	233	MITHILA	1.62	1668
9	BANKURA	BANKURA-II	BIKNA	MOBARAKPUR	234	MOBARAKPUR	1.5	1195
10	BANKURA	BANKURA-II	JUNBEDIA	BELDANGRA	44	BELDANGRA	1.5	944
11	BANKURA	BANKURA-II	JUNBEDIA	HARIYARGARA	50	HARIYARGARA	1.58	1722
12	BANKURA	BANKURA-II	JUNBEDIA	PANCHBAGA	225	PANCHBAGA	3.06	1361
13	BANKURA	BANKURA-II	MAUKANALI	BHANGA HIRA	12	BHANGAHIRA	2.5	413
14	BANKURA	BANKURA-II	MAUKANALI	KENDBANI	3	KENDBANI	1.7	843
15	BANKURA	BANKURA-II	MAUKANALI	LADNA	11	LADNA	3.95	813
16	BANKURA	BANKURA-II	MAUKANALI	LAPURIA	2	LAPURIA	2.42	1219
17	BANKURA	BANKURA-II	MAUKANALI	SONAMUI	22	MANKANALI MAZH PARA	4.57	1016
18	BANKURA	BANKURA-II	MAUKANALI	SONAREKH	20	SONAREKH	1.73	707
19	BANKURA	BANKURA-II	PUANDARPUR	TILABEDYA	239	DARMADASPUR	1.8	681
20	BANKURA	BANKURA-II	PUANDARPUR	MANOHARPUR	241	KAMLADANGA	5.1	736
21	BANKURA	BANKURA-II	PUANDARPUR	TILABEDYA	239	TILYABENDYA	2.33	766
22	BANKURA	BANKURA-II	SANBANDA	BHUJ SOHAR	208	BAGA	1.8	450
23	BANKURA	BANKURA-II	SANBANDA	EKTESWAR	202	EKTESWAR	4.8	2039
24	BANKURA	BANKURA-II	SANBANDA	SYAMDASPUR	206	KERANIBAND	1.66	1446
25	BANKURA	BANKURA-II	SANBANDA	SANKARHATI	203	MURRA	4.5	219
26	BANKURA	BANKURA-II	SANBANDA	SANKARHATI	203	SANKARHATI	2.7	262
27	BANKURA	BANKURA-II	SANBANDA	SYAMDASPUR	206	SHYAMDASPUR	1.9	2185
28	BANKURA	BARJORA	BARJORA	BARJORA (CT)	46	BARJORA	5.86	11512
29	BANKURA	BARJORA	BARJORA	BARJORA (CT)	46	BAURI PARA	1.55	11
30	BANKURA	BARJORA	BARJORA	BARJORA (CT)	46	CO OPERATIVE PARA	1.9	19
31	BANKURA	BARJORA	BARJORA	BARJORA (CT)	46	URAN PARA	1.54	7
32	BANKURA	BARJORA	BELIATORE	BELIATORE (CT)	130	BELIATORE	1.52	5654
33	BANKURA	BARJORA	BELIATORE	NUTANGRAM	122	NUTANGRAM	6.22	1919
34	BANKURA	BARJORA	BRINDABANPUR	SWARGABATI	171	SARGABASI	2.51	200
35	BANKURA	BARJORA	CHHANDAR	CHHANDAR	151	CHHANDAR	1.82	1776
36	BANKURA	BARJORA	GHUTGORIA	GHUTGARYA	24	GHUTGORIA	1.57	5739
37	BANKURA	BARJORA	GHUTGORIA	MONOHAR	8	MONOHAR	1.63	1475
38	BANKURA	BARJORA	GHUTGORIA	PRATAPPUR	15	PRATAPPUR	2.03	1735
39	BANKURA	BARJORA	GHUTGORIA	TIKARGRAM	11	TIKARGRAM	1.52	982
40	BANKURA	CHHATNA	ARRAH	ARRA	155	ARRAH	6.5	1672
41	BANKURA	CHHATNA	ARRAH	GUNIADA	164	GUNIADA	4.25	123
42	BANKURA	CHHATNA	ARRAH	SIHIKAPAHARI	50	SIHIKAPAHARI	1.68	433
43	BANKURA	CHHATNA	CHHATNA	AGAYA	98	AGAYA	1.68	753
44	BANKURA	CHHATNA	CHHATNA	BHARATPUR	95	BHARATPUR	1.62	403
45	BANKURA	CHHATNA	CHHATNA	GIDHURIA	96	GIDHURIA	4.78	721
46	BANKURA	CHHATNA	CHHATNA	HAPANIA	83	HAPANIA	3.26	349
47	BANKURA	CHHATNA	CHHATNA	NAMA SHUSHUNIA	88	NAMO SUSUNIA	1.62	402
48	BANKURA	CHHATNA	CHHATNA	PAHAR GHATA	87	PAHARGHATA	1.68	1830
49	BANKURA	CHHATNA	CHHATNA	PHAPSA	79	PHAPSA	2.01	369
50	BANKURA	CHHATNA	CHHATNA	RAMNATHPUR	82	RAMNATHPUR	2.49	879
51	BANKURA	CHHATNA	CHHATNA	SHUSHUNIA	89	SUSUNIA	2.79	635
52	BANKURA	CHHATNA	CHHATNA-I	KANTASOL	113	CHHATNA	1.84	2753
53	BANKURA	CHHATNA	CHHATNA-II	GHORAMULI	120	HATISAL	3.29	937
54	BANKURA	CHHATNA	CHINABARI	AMAKUNDA	190	AMAKUNDA	1.54	424
55	BANKURA	CHHATNA	CHINABARI	DUMDA	172	DUMDA	1.62	457
56	BANKURA	CHHATNA	CHINABARI	RANGAMETIA	200	RANGAMETIA	1.5	987
57	BANKURA	CHHATNA	DHABAN	JALHARI	7	BHALAKULI	2.24	242
58	BANKURA	CHHATNA	DHABAN	DHABAN	22	DHABAN	1.56	1543
59	BANKURA	CHHATNA	DHABAN	KHABANIGOPARPUR	18	GOPAL PUR	1.79	624
60	BANKURA	CHHATNA	DHABAN	JALHARI	7	JALHARI	2.83	538
61	BANKURA	CHHATNA	DHABAN	TALJHARIA	20	KENDAMURA	2.48	342

Drinking Water Quality Action Plan - Bankura
West Bengal Water Supply Improvement Investment Program

Water Quality Results (PHED)

Sl	District	Block	Panchayat	Village	JL no.	Habitation	Maximum Fluoride Concentration (mg/lt)	Population
62	BANKURA	CHHATNA	DHABAN	KUMIRDOHA	12	KUMIRDOHA	1.96	277
63	BANKURA	CHHATNA	DHABAN	NARASHOL	11	NARASHOL	1.69	166
64	BANKURA	CHHATNA	DHABAN	RAMPUR	17	RAMPUR	1.66	443
65	BANKURA	CHHATNA	DHABAN	SANPURA	10	SANPURIA	1.69	973
66	BANKURA	CHHATNA	DHABAN	SIDHABERIA	25	SIDABARI	1.75	727
67	BANKURA	CHHATNA	DHABAN	TALJHARIA	20	TALJHARIA	3.84	473
68	BANKURA	CHHATNA	DHABAN	UPARGARA	19	UPARGARA	2.42	766
69	BANKURA	CHHATNA	GHOSERGRAM	LOHAGAR	133	BANDAGAL	1.82	116
70	BANKURA	CHHATNA	GHOSERGRAM	DUMDUMI	140	DUMDUMI	1.99	1290
71	BANKURA	CHHATNA	GHOSERGRAM	GHAR MORA	131	GHAR MORA	1.81	808
72	BANKURA	CHHATNA	GHOSERGRAM	MUSIBDIHI	132	MUSIB DIHI	8.12	401
73	BANKURA	CHHATNA	GHOSERGRAM	LOHAGAR	133	NUTAN LOHAGHAR	1.78	548
74	BANKURA	CHHATNA	GHOSERGRAM	LOHAGAR	133	RANGA GORA	1.7	181
75	BANKURA	CHHATNA	GHOSERGRAM	SHUKUNI BANSA	144	SHUKNI BASA	1.73	840
76	BANKURA	CHHATNA	GHOSERGRAM	SIULI PAHARI	143	SULI PAHARI	1.61	1031
77	BANKURA	CHHATNA	JAMTORA	ANTKURIA	213	ANTKURIA	2.12	779
78	BANKURA	CHHATNA	JAMTORA	CHAINTOR	205	CHAINTORE	1.61	473
79	BANKURA	CHHATNA	JAMTORA	KHAEABANI	212	KHAERBONI	2.65	280
80	BANKURA	CHHATNA	JAMTORA	MANTUMURA	217	MANTOMRA	1.62	759
81	BANKURA	CHHATNA	JAMTORA	UPAR DIHI	214	UPARDIHI	1.65	395
82	BANKURA	CHHATNA	JHUNJKA	BISHKODAR	91	BISHKODAR	1.61	839
83	BANKURA	CHHATNA	JHUNJKA	HAUSIBAD	64	HAUSI BAD	3.08	632
84	BANKURA	CHHATNA	JHUNJKA	SHIRPURA	72	SHIR PURA	1.7	388
85	BANKURA	CHHATNA	SALDIHA	BALIGUMA	222	BALIGUMA	1.63	685
86	BANKURA	CHHATNA	SALDIHA	LAKSHMISHOL	228	SANTALDIHI	2.64	56
87	BANKURA	CHHATNA	SALDIHA	SURIBEDIA	233	SURALDIHI	1.58	200
88	BANKURA	CHHATNA	TEGJORI	KENDSAER	273	KENDASAER	1.87	729
89	BANKURA	CHHATNA	TEGJORI	DANMARI	271	KUREABAID	1.56	161
90	BANKURA	CHHATNA	TEGJORI	LARI	275	LORI	1.85	574
91	BANKURA	CHHATNA	TEGJORI	RADHA NAGAR	278	RADHANAGAR	1.83	129
92	BANKURA	GANGAJAL GHATI	BANASURIA	BELDANGA	48	BELDANGA	2	1219
93	BANKURA	GANGAJAL GHATI	BANASURIA	BHALUKATHOL	43	BHALUKATHOLE	1.67	401
94	BANKURA	GANGAJAL GHATI	BANASURIA	CHHOTA LALPUR	53	CHHOTOLALPUR	2	655
95	BANKURA	GANGAJAL GHATI	BANASURIA	KUSTHALIA	49	KUSTHOLIA	2	1902
96	BANKURA	GANGAJAL GHATI	BANASURIA	NARAYANPUR	50	NARAYANPUR	2	147
97	BANKURA	GANGAJAL GHATI	BANASURIA	RANGA METYA	61	RANGAMETYA	2	919
98	BANKURA	GANGAJAL GHATI	BARSHAL	CHAUSAL	14	RADHAMADHABPUR	1.95	1521
99	BANKURA	GANGAJAL GHATI	BARSHAL	SRICHANDRAPUR	16	SRICHANDRAPUR	1.69	1243
100	BANKURA	GANGAJAL GHATI	GANGAJALGHATI	KESHIARA	81	BHARATPUR	2.32	95
101	BANKURA	GANGAJAL GHATI	GOBINDADHAM	AMJOR	98	KHUDERDANGA	1.87	256
102	BANKURA	GANGAJAL GHATI	GOBINDADHAM	KONRA	105	KORO	2.75	692
103	BANKURA	GANGAJAL GHATI	KAPISTA	KAPISHTHA	115	KAPISTA	1.51	3242
104	BANKURA	GANGAJAL GHATI	LATIA BONI	NANDANPUR	41	AMDANGA	1.78	208
105	BANKURA	GANGAJAL GHATI	LATIA BONI	DURLABHPUR	33	DURLOVPUR	1.85	1725
106	BANKURA	GANGAJAL GHATI	LATIA BONI	BENAGARI	32	PARUIBAID	1.58	793
107	BANKURA	GANGAJAL GHATI	NITYANANDAPUR	ANANDAPUR	19	ANANDAPUR	1.67	545
108	BANKURA	GANGAJAL GHATI	NITYANANDAPUR	CHAITANYAPUR	21	CHAITANYAPUIR	1.81	902
109	BANKURA	GANGAJAL GHATI	NITYANANDAPUR	SIBIPARA	25	DANGAPARA	1.78	669
110	BANKURA	GANGAJAL GHATI	NITYANANDAPUR	SIBIPARA	25	SUBIRARA	2.17	1521
111	BANKURA	HIRBANDH	BAHARAMURI	RANGAMATI	141	RANGAMATI	1.6	295
112	BANKURA	HIRBANDH	GOPALPUR	GOPALPUR	11	SALPARA	1.65	171
113	BANKURA	HIRBANDH	HIRBANDH	CHAKADOBA	73	CHAKADOBA	1.68	171
114	BANKURA	HIRBANDH	HIRBANDH	GOBARDA	152	KELAPATHAR	1.99	121
115	BANKURA	HIRBANDH	MOLIAN	CHANPASOL	78	CHAMPASOLE	1.69	1100
116	BANKURA	HIRBANDH	MOLIAN	DEBIDIA	86	DEBEDIA	10.2	392
117	BANKURA	HIRBANDH	MOLIAN	TENTULIA	27	DHULATAPI	10.8	206
118	BANKURA	HIRBANDH	MOLIAN	BRAHMA DANGA	33	NAPITDIHI	1.68	279
119	BANKURA	HIRBANDH	MOSHIARA	DHARAMPUR	53	BANKATI	1.96	134
120	BANKURA	HIRBANDH	MOSHIARA	DHARAMPUR	53	DHARAMPUR	1.54	352
121	BANKURA	INDPUR	BHEDUASOLE	KALPATHAR	178	KALPATHAR	7.09	674
122	BANKURA	INDPUR	BRAHMANDIHA	PADULARA	60	PADULARA	1.62	1560

Drinking Water Quality Action Plan - Bankura
West Bengal Water Supply Improvement Investment Program

Water Quality Results (PHED)

Sl	District	Block	Panchayat	Village	JL no.	Habitation	Maximum Fluoride Concentration (mg/lt)	Population
123	BANKURA	INDPUR	BRAJARAJPUR	BOTKULA	156	BOTKULA	1.62	398
124	BANKURA	INDPUR	BRAJARAJPUR	GUNNATH	172	HARIDIHI	4.89	177
125	BANKURA	INDPUR	HATAGRAM	KAJAL KURA	31	PARASIBAN	1.63	58
126	BANKURA	INDPUR	HATAGRAM	UTTARPAIRACHALI	13	UTTAR PAIRACHALI	6.4	2246
127	BANKURA	INDPUR	INDPUR	KRISHNANAGAR	126	KRISHNANAGAR	1.52	336
128	BANKURA	INDUS	INDAS-I	JINKARA	19	JINKARA	1.59	727
129	BANKURA	KHATRA	BAIDYANATHPUR	JAGANNATHPUR	110	JAGANNATHPUR	5.28	505
130	BANKURA	KHATRA	BAIDYANATHPUR	JASARA	119	JOSARA	6.95	767
131	BANKURA	KHATRA	BAIDYANATHPUR	NAGRI	116	NAGRI	3.76	1259
132	BANKURA	KHATRA	DHANARA	KASIPUR	230	BAURIPARA	1.66	147
133	BANKURA	KHATRA	DHANARA	DUMURIA	254	BAURIPARA	2.26	195
134	BANKURA	KHATRA	DHANARA	CHAKA	237	CHAKA	1.8	695
135	BANKURA	KHATRA	DHANARA	SINDURPETI	239	PAINPARA	1.69	273
136	BANKURA	KHATRA	DHANARA	SABUDAD	253	SABUBAID	1.98	330
137	BANKURA	MEJHIA	BANJORA	BANJORA	73	BANJORA	1.67	1492
138	BANKURA	MEJHIA	BANJORA	DEBAGRAM	66	DEBAGRAM	3.22	361
139	BANKURA	MEJHIA	BANJORA	JALANPUR	74	JALANPUR	1.83	982
140	BANKURA	MEJHIA	KUSTORE	KUSTOR	26	KUSTORE	1.5	3278
141	BANKURA	ONDA	LODNA	BAIDYANATHPUR	80	DHAGARIA	2.46	444
142	BANKURA	ONDA	NAKAIJURI	CHAK MUKTAPUR	172	PATHARKATA	6.75	434
143	BANKURA	RAIPUR	FULKUSHMA	NAMOSOL	314	NAMASOL	1.5	236
144	BANKURA	RAIPUR	FULKUSHMA	PAKADIHI	318	PAKADIHI	1.7	185
145	BANKURA	RAIPUR	FULKUSHMA	MANDALDIHA	315	TENTULDANGA	1.91	230
146	BANKURA	RAIPUR	MATGODA	JADAB NAGAR	167	ASANBONI	1.5	232
147	BANKURA	RAIPUR	RAIPUR	DHARAMPUR	140	DHARAMPUR	4.67	886
148	BANKURA	RAIPUR	RAIPUR	RAIPUR BAZAR	139	RAIPUR BAZAR	3.94	7062
149	BANKURA	SALTORA	BAMUNTORE	ISWARDA	31	ISWARDA	2.16	793
150	BANKURA	SALTORA	BAMUNTORE	KESHAR KUNDI	28	KESHAR KURI	1.8	389
151	BANKURA	SALTORA	DHEKIT	RANIPUR	71	RANIPUR	1.65	92
152	BANKURA	SALTORA	GOGRA	NETKAMLA	156	NET KAMALA	1.94	1253
153	BANKURA	SALTORA	KANURI	BARKONA	151	BARKONA	2.2	2462
154	BANKURA	SALTORA	KANURI	BANSH KETIA	116	BASKATIYA	3.97	184
155	BANKURA	SALTORA	KANURI	CHHATA PATHAR	119	CHATTA PATHAR	3.42	926
156	BANKURA	SALTORA	KANURI	DHATLA	115	DHATOLA	1.66	1185
157	BANKURA	SALTORA	KANURI	GOT	138	GOTE	2.07	1028
158	BANKURA	SALTORA	KANURI	RAGHUNATH CHAK	117	RAGHUNATH CHAK	1.99	427
159	BANKURA	SALTORA	KANURI	RAJ BANDH	134	RAJBAND	1.57	359
160	BANKURA	SALTORA	KANURI	RAMPUR	118	RAMPUR	2.28	1237
161	BANKURA	SALTORA	KANURI	TILABAID	132	TELABAID	2.16	1024
162	BANKURA	SALTORA	PABRA	DEMRAMOL	126	DAMRAMOL	2.88	633
163	BANKURA	SALTORA	PABRA	MANIPUR	131	MANIPUR	3.41	68
164	BANKURA	SALTORA	PABRA	PIRRABAID DHOLAR BANDH	121	PIDRABIDE	3.59	426
165	BANKURA	SALTORA	PABRA	RAMJIBANPUR	85	RAMJIBANPUR	1.5	396
166	BANKURA	SALTORA	PABRA	RANIPUR	130	RANIPUR	3.22	678
167	BANKURA	SALTORA	PABRA	SHALROHA	123	SALROHA	2.68	1552
168	BANKURA	SALTORA	SALTORA	SHIARBEDIA	106	ARADANG	1.65	644
169	BANKURA	SALTORA	SALTORA	MAUCHURIA	111	MOUCHURIA	2.5	418
170	BANKURA	SALTORA	SALTORA	SALTORA	108	SALTORA	2.3	3749
171	BANKURA	SALTORA	SALTORA	SHIARBEDIA	106	SEARBEDIA	2.02	1132
172	BANKURA	SALTORA	SALTORA	SHYAMPUR	112	SHYAMPUR	1.6	2059
173	BANKURA	SALTORA	TILURI	JAHUR BANA	102	JAHURBONA	1.98	381
174	BANKURA	SALTORA	TILURI	LAKSHANKATA	15	LAKHNA KATA	1.59	268
175	BANKURA	SALTORA	TILURI	SIAKULDOBA	75	SIAKULDOBA	1.85	289
176	BANKURA	SALTORA	TILURI	SIMLADIHI	100	SIMLADIHI	2.23	587
177	BANKURA	SARENGA	CHILTORE	GUNIADA	24	GUNIADA	2.01	806
178	BANKURA	SARENGA	GOALBARI	GOALBARI	128	GOALBARI	6.66	1752
179	BANKURA	SIMLAPAL	BIKRAMPUR	ASNA	72	ASNA	1.56	422
180	BANKURA	SIMLAPAL	BIKRAMPUR	BARAHETYAGARA	65	BARA HETYAGARA	1.93	1637
181	BANKURA	SIMLAPAL	BIKRAMPUR	JARISA	89	BELGERIA	9.86	349
182	BANKURA	SIMLAPAL	BIKRAMPUR	KALABATI	79	BHAJAHARIPUR	1.69	209
183	BANKURA	SIMLAPAL	BIKRAMPUR	BHANGABANDH	78	BHANGABANDH	1.92	451

Drinking Water Quality Action Plan - Bankura
West Bengal Water Supply Improvement Investment Program

Water Quality Results (PHED)

Sl	District	Block	Panchayat	Village	JL no.	Habitation	Maximum Fluoride Concentration (mg/lt)	Population
184	BANKURA	SIMLAPAL	BIKRAMPUR	BHUDRUBAD	69	BHURRUBAID	1.69	277
185	BANKURA	SIMLAPAL	BIKRAMPUR	KANIABALI	63	CHAKBAID	1.52	665
186	BANKURA	SIMLAPAL	BIKRAMPUR	ASNA	72	CHHOLAGORA	1.56	161
187	BANKURA	SIMLAPAL	BIKRAMPUR	DHANISUKNI	74	DHANISUKNI	1.59	404
188	BANKURA	SIMLAPAL	BIKRAMPUR	JARISA	89	DOGIRA	1.56	1781
189	BANKURA	SIMLAPAL	BIKRAMPUR	BARAMAKARKOL	70	GOPALNAGAR	1.67	608
190	BANKURA	SIMLAPAL	BIKRAMPUR	HARINTULI	62	HARINTULI	1.54	855
191	BANKURA	SIMLAPAL	BIKRAMPUR	BARAMAKARKOL	70	JOGMOHANPUR	1.52	494
192	BANKURA	SIMLAPAL	BIKRAMPUR	JARISA	89	JORISHA	1.84	1355
193	BANKURA	SIMLAPAL	BIKRAMPUR	KALABATI	79	KALABATI	1.68	279
194	BANKURA	SIMLAPAL	BIKRAMPUR	KANTASOLA	77	KANTASOLA	1.52	170
195	BANKURA	SIMLAPAL	BIKRAMPUR	KATHJURIA	60	KATAJURIA	1.52	260
196	BANKURA	SIMLAPAL	BIKRAMPUR	KUMARDOBA	82	LADNA	1.68	260
197	BANKURA	SIMLAPAL	BIKRAMPUR	NIMAIPUR	80	LOHADI	1.58	771
198	BANKURA	SIMLAPAL	BIKRAMPUR	BARDI	88	MADHABPUR	2.63	233
199	BANKURA	SIMLAPAL	BIKRAMPUR	NIMAIPUR	80	NEMAIPUR	1.59	349
200	BANKURA	SIMLAPAL	BIKRAMPUR	SIRSHA	81	SIRSHA	1.58	309
201	BANKURA	SIMLAPAL	BIKRAMPUR	ASNA	72	TILABANI	1.92	963
202	BANKURA	SIMLAPAL	DUBRAJPUR	KHAMARDANGA	161	ANKRA	1.56	235
203	BANKURA	SIMLAPAL	DUBRAJPUR	PITHABAKRA	174	BIJLI	1.59	111
204	BANKURA	SIMLAPAL	DUBRAJPUR	CHANDPUR	172	CHANDPUR	1.96	659
205	BANKURA	SIMLAPAL	DUBRAJPUR	HATIBARI	166	DOMANI	1.56	87
206	BANKURA	SIMLAPAL	DUBRAJPUR	DUBRAJPUR	168	DUBRAJPUR	1.96	2731
207	BANKURA	SIMLAPAL	DUBRAJPUR	JHUMKA	156	JHUMKA	1.96	356
208	BANKURA	SIMLAPAL	DUBRAJPUR	LAKSHMIPAL	158	KOLGANGU	1.52	195
209	BANKURA	SIMLAPAL	DUBRAJPUR	JHUMKA	156	MADARIA	1.52	265
210	BANKURA	SIMLAPAL	DUBRAJPUR	PUTIADAHA	173	PUTIADAHA	1.91	630
211	BANKURA	SIMLAPAL	DUBRAJPUR	PUIPAL	160	THANDAPARA	1.56	164
212	BANKURA	SIMLAPAL	LAKSHMISAGAR	BHELAIDIHA	36	ALKADHARA	1.52	265
213	BANKURA	SIMLAPAL	LAKSHMISAGAR	BANKATA	31	BANKATA	1.52	612
214	BANKURA	SIMLAPAL	LAKSHMISAGAR	BANKHOLA	54	BANKHOLA	1.59	516
215	BANKURA	SIMLAPAL	LAKSHMISAGAR	SARENGA	50	BAN-SARENGA	1.52	398
216	BANKURA	SIMLAPAL	LAKSHMISAGAR	JUGIDANGRA	47	BELDANGA	1.56	107
217	BANKURA	SIMLAPAL	LAKSHMISAGAR	BAURISOL	42	BOURISOLE	1.52	340
218	BANKURA	SIMLAPAL	LAKSHMISAGAR	JHIKRI	40	BURIRDANGA	1.51	61
219	BANKURA	SIMLAPAL	LAKSHMISAGAR	JUNBAKRA	35	DOLDERIA	1.93	761
220	BANKURA	SIMLAPAL	LAKSHMISAGAR	JUGIDANGRA	47	DULALPUR	1.52	346
221	BANKURA	SIMLAPAL	LAKSHMISAGAR	GOTKANALI	45	GOTKANALI	1.54	298
222	BANKURA	SIMLAPAL	LAKSHMISAGAR	TILABANI	39	GULIPARA	1.54	153
223	BANKURA	SIMLAPAL	LAKSHMISAGAR	KHARIKA	27	HARIPARA	1.56	88
224	BANKURA	SIMLAPAL	LAKSHMISAGAR	TILABANI	39	HARITAKIDANGA	2	189
225	BANKURA	SIMLAPAL	LAKSHMISAGAR	JAMDA	38	JAMDA	1.96	490
226	BANKURA	SIMLAPAL	LAKSHMISAGAR	JHIKRI	40	JHIKRI	1.51	482
227	BANKURA	SIMLAPAL	LAKSHMISAGAR	JUGIDANGRA	47	JUGIDANGRA	1.52	239
228	BANKURA	SIMLAPAL	LAKSHMISAGAR	JUNBAKRA	35	JUNBAKRA	1.52	416
229	BANKURA	SIMLAPAL	LAKSHMISAGAR	KHARIKA	27	KHARKA	6.23	342
230	BANKURA	SIMLAPAL	LAKSHMISAGAR	LAKSHMISAGAR	43	LAKSHMISAGAR	4.91	3603
231	BANKURA	SIMLAPAL	LAKSHMISAGAR	BHELAIDIHA	36	LALADHAR	1.56	54
232	BANKURA	SIMLAPAL	LAKSHMISAGAR	BANKHOLA	54	LALITDHARA	1.52	9
233	BANKURA	SIMLAPAL	LAKSHMISAGAR	MAIDHARA	46	MAIDHARA	1.57	881
234	BANKURA	SIMLAPAL	LAKSHMISAGAR	KHARIKA	27	NAMAPARA	1.58	132
235	BANKURA	SIMLAPAL	LAKSHMISAGAR	JHIKRI	40	NIMDANGA	1.61	71
236	BANKURA	SIMLAPAL	LAKSHMISAGAR	NUTANGAR	34	NUTANGARH	1.82	1044
237	BANKURA	SIMLAPAL	LAKSHMISAGAR	JUNBAKRA	35	PANDAPARA	1.52	341
238	BANKURA	SIMLAPAL	LAKSHMISAGAR	RASIKPUR	48	RASIKPUR	1.52	230
239	BANKURA	SIMLAPAL	LAKSHMISAGAR	LAKSHMISAGAR	43	ROUTPARA	1.56	385
240	BANKURA	SIMLAPAL	LAKSHMISAGAR	SHYAMPUR	44	SHYAMPUR	1.92	221
241	BANKURA	SIMLAPAL	LAKSHMISAGAR	SINYAJORA	32	SINAJARA	1.58	102
242	BANKURA	SIMLAPAL	LAKSHMISAGAR	BHELAIDIHA	36	SINGARPAL	3.84	54
243	BANKURA	SIMLAPAL	LAKSHMISAGAR	SARENGA	50	TELIPARA	1.56	203
244	BANKURA	SIMLAPAL	LAKSHMISAGAR	TILABANI	39	TILABONI	1.69	742

Drinking Water Quality Action Plan - Bankura
West Bengal Water Supply Improvement Investment Program

Water Quality Results (PHED)

Sl	District	Block	Panchayat	Village	JL no.	Habitation	Maximum Fluoride Concentration (mg/lt)	Population
245	BANKURA	SIMLAPAL	LAKSHMISAGAR	JUGIDANGRA	47	TISRA	1.92	71
246	BANKURA	SIMLAPAL	MACHATORA	SOVARAJPUR	104	SOVRAJPUR	1.81	350
247	BANKURA	SIMLAPAL	MACHATORA	TAPUBAID	106	TAPUBAID	1.5	489
248	BANKURA	SIMLAPAL	MONDALGRAM	ARRA	197	ARRAH	1.51	979
249	BANKURA	SIMLAPAL	MONDALGRAM	BAMUN PATHRI	187	BAMUN PATHRI	1.56	431
250	BANKURA	SIMLAPAL	MONDALGRAM	BHUTSAHAR	199	BHUTSAHAR	1.51	1582
251	BANKURA	SIMLAPAL	MONDALGRAM	JAMBEDIA	179	DASPARA	1.59	277
252	BANKURA	SIMLAPAL	MONDALGRAM	PACHAPARAR	186	PACHA PARAR	1.54	80
253	BANKURA	SIMLAPAL	MONDALGRAM	RUNIARA	132	RUNIRHA	1.92	400
254	BANKURA	SIMLAPAL	PARSOLA	BARADHARA	17	BARADHARA	1.52	450
255	BANKURA	SIMLAPAL	PARSOLA	PUKHURIA	10	GOLAKPUR	1.5	153
256	BANKURA	SIMLAPAL	PARSOLA	GURIGHATI	25	GURIAGHATI	1.5	529
257	BANKURA	SIMLAPAL	PARSOLA	KALSULI	22	KALSULI	1.59	457
258	BANKURA	SIMLAPAL	PARSOLA	MADHABPUR	11	MADHABPUR	1.58	254
259	BANKURA	SIMLAPAL	PARSOLA	KUKRAKHONDAR	18	MALIK PARA	1.62	114
260	BANKURA	SIMLAPAL	PARSOLA	MAMRA	16	MAMRA	1.53	825
261	BANKURA	SIMLAPAL	PARSOLA	BHALKAMURI	23	PAHARIDANGA	1.5	343
262	BANKURA	SIMLAPAL	PARSOLA	PARSALA	28	PARSOLA	1.59	2689
263	BANKURA	SIMLAPAL	PARSOLA	RAMGAR	33	PODERDIHI	1.5	117
264	BANKURA	SIMLAPAL	PARSOLA	PUKHURIA	10	PUKURIA	1.59	1094
265	BANKURA	SIMLAPAL	PARSOLA	RAMCHANDRAPUR	5	RAMCHANDRAPUR	1.52	370
266	BANKURA	SIMLAPAL	PARSOLA	RENGURBANDH	14	RENGURBANDH	1.51	320
267	BANKURA	SIMLAPAL	PARSOLA	BHALKAMURI	23	VELKAMURI	1.5	470
268	BANKURA	SIMLAPAL	SIMLAPAL	BADAGERIA	128	BADAGERIA	1.56	702
269	BANKURA	SIMLAPAL	SIMLAPAL	BALARAMPUR	123	BALARAMPUR	1.96	578
270	BANKURA	SIMLAPAL	SIMLAPAL	GHUGIA	142	GOTORA	1.69	265
271	BANKURA	SIMLAPAL	SIMLAPAL	JAMIRDIHA	135	JAMIRDIHA	1.56	464
272	BANKURA	SIMLAPAL	SIMLAPAL	KAYMA	150	KOYMA	1.62	162
273	BANKURA	SIMLAPAL	SIMLAPAL	KRISHNAPUR	137	KRISHNAPUR	1.51	810
274	BANKURA	SIMLAPAL	SIMLAPAL	MADHABPUR	146	LAYLKPARA	1.51	733
275	BANKURA	SIMLAPAL	SIMLAPAL	MADHUPUR	134	MADHUPUR	1.59	321
276	BANKURA	SIMLAPAL	SIMLAPAL	MADHUPUR	134	MALIDI	1.52	106
277	BANKURA	SIMLAPAL	SIMLAPAL	MUKUNDAPUR	152	MUKUNDARAM	1.56	691
278	BANKURA	SIMLAPAL	SIMLAPAL	PATAMECHLA	144	PATAMACHLA	1.56	400
279	BANKURA	SONAMUKHI	PANCHAL	ICHHARIA	155	ICHHARIA	9	1069
280	BANKURA	TALDANGRA	FAL BIBARDA	HARAKONA	63	KHERISOLE	1.94	175
281	BANKURA	TALDANGRA	FAL BIBARDA	BIBARDA	6	MEDINA	2.11	5399
282	BANKURA	TALDANGRA	HARMASRA	HARMASRA	28	HARMASRA	3.65	2972
283	BANKURA	TALDANGRA	HARMASRA	KOLSULI	50	KOLSULI	1.78	221
284	BANKURA	TALDANGRA	HARMASRA	MAHISHAKANALI	42	MAHISHAKANALI	1.57	117
285	BANKURA	TALDANGRA	HARMASRA	MARASOL	27	MARASOLE	3.33	294
286	BANKURA	TALDANGRA	KHALGRAM	PAINADA MODARPUR	18	AGOYAUPARPARA	2.32	152
287	BANKURA	TALDANGRA	KHALGRAM	PAIKA	9	PAIKA	1.57	545
288	BANKURA	TALDANGRA	KHALGRAM	KADAMARA	17	PATHARKURIA	9.28	168
289	BANKURA	TALDANGRA	PANCHMURA	LALBANDH	109	LALBANDH	1.94	1337
290	BANKURA	TALDANGRA	PANCHMURA	NUTANGRAM	97	NATUNGRAM	1.66	688
291	BANKURA	TALDANGRA	TALDANGRA	RADHAMOHANPUR	58	RADHAMOHANPUR	2.74	607

Annexure-09: Water Supply Schemes in Bankura District

Table 1: Commissioned WS Schemes based on Ground Water

Sl. No	Block	Name of the Scheme	Year Completed	Nos. of Habitations covered	Design Population
1	Bankura-I	Kenjukura	1978-79	8	16168
		Kargihir	1994-95	1	1473
2	Bankura-II	Bikna	2002-03	7	5957
3	Barjora	Beliatore	1989-90	11	12573
		Barjora	1990-91	55	70445
4	Chhatna	Jhantipahari	1977-78	16	16773
		Salberia	1981-82	60	35585
5	Bishnupur	Kulupur Hikim Danga	2003-04	3	1092
		Chitrang		2	552
6	Gangajalghati	Charadihi	1966-67	13	8154
7	Indpur, Bankura-I	Indpur	2001-02	16	15838
8	Indus	Indus	1996-97	15	15619
9	Joypur	Joypur	2000-01	20	14670
		Shyamnagar	2003-04	1	1134
		Mugura	1983-84	1	1892
		Moynapura Rural	2006-07	1	5256
10	Khatra	Khatra	2002-03	11	7382
11	Kotulpur	Kotulpur	1977-78	26	
		Madanmohanpur	2003-04	6	
		Gopal Ganj. Ramdiha	2003-04	2	
		Joyrambati	1980-81	11	
12	Mejhia	Mejhia	2000-01	7	19766
13	Onda	Onda	1987-88	45	43117
		Khapara Malapara	2003-04	1	1530
		Pachara	2003-04	1	342
14	Patrasayer	NabaKishore	1994-95	68	20150
		Patrasayer	1992-93	2	10844
15	Raipur	Mukundaur	2002-03	21	5406
		Raipur	1990-91	6	9519
16	Saltora	Saltora	1978-79	28	23024
17	Sarenga	Sarenga	1988-89	-	12124
		Choto Brihanpur	2005-06	3	4336
18	Simlapal	Simplapal	1996-97	18	12046
		Adibasipara and Loharpara	2003-04	5	5304
		Jamirdiha Godabahara & Krishnapur	2003-04	4	1518
19	Sonamukhi	Rampur	1991-92	29	9068
		Panchal	2011-12	55	18378
20	Taldangra	Joypur and Adhikara	2003-04	9	4946
		Bibarda	2003-04	1	5399
		Taldangra	1996-97	17	10363

Table 2: Commissioned WS Schemes based on Surface / Sub-Surface Source

Sl. No	Block	Name of the Scheme (Source)	Year Completed	Nos. of Habitations covered	Design Population
A	Sub-Surface Based WS Scheme				
1	Bankura-II	Ekteshwar (River Dwarakeswar)	2010-11	15	25236
2	Chhatna	Kanki (River Dwarakeswar)	2012-13	6	1762
3	Indpur	Goaladanga & its adjoining Mouzas (River Silabati)	2011-12	18	8040
4	Mejhia	Bharah (River Damodar)	2011-12	10	8373
5	Raipur	Dahanara & its adjoining Mouzas (River Kangsabati)	2011-12	30	14818
6	Saltora	Sabur Bandh (River Damodar)	2011-12	19	10445
7	Sarenga	Phulberia (River Kangsabati)	2011-12	19	8510
		Chiltore & its adjoining Mouzas (River Kangsabati)	2011-12	12	7204
8	Simlapal	Laksmisagar & it adjoining Mouzas (River Silabati)	2011-12	62	24210
B	Surface Based				
1	Khatra, Ranibundh	Mukutmanipur, Khatra and Ranibundh	2001-02	216	72645
2	Gangajalghati	Gangajalghati	2000-01	26	22343

Table 3: Commissioned WS Schemes based on Un-conventional Sources

Sl. No	**Block**	**Name of the Scheme**	**Source**	**Year Completed**	**Nos. of Habitations covered**	**Design Population**
1	Bankura-I	Sonabundh	Rain water Harvesting	1977-78	9	12301
2	Khatra	Ekalabya Residential Model	Rain water Harvesting	2008-09	5	2396
3	Bishnupur, Taldangra	Dual Use-Solar Pump	Ground-water through Solar pumps	2013-14	66	

Table 4: Ongoing Water Supply Schemes: Bankura

Sl. No	Block	Name of the Scheme	Source	Year of Sanction	Nos. of Habitations covered	Design Population
1	Saltora	Salma	Sub-surface (Damodar)	2011-12	24	21299
2	Barjora	Pakhanna & its adjoining Mouzas	Sub-surface (Damodar)	2011-12	41	13161
3	Indus	Somsar	Ground Water	2011-12	3	4421
4	Bishnupur	Radhanagar	Sub-surface (Dwarakeshwar)	2012-13	33	34220
5	Mejhia	Mejhia	Sub-surface (Damodar)	2012-13	11	18720
6	Raipur	Raipur	Sub-surface (Kangsabati)	2013-14	48	32713

Annexure-10: Fluoride contamination in habitations and affected populations, Blocks Not Covered under BRGF

Table 1:Fluoride affected Habitation in Mejhia Block

Sl. Nos.	Name of Gram Panchayat	Village	JL No:	Habitation	Population	Maxm. Fluoride Concentration (In Mg/l)
1	Banjora	Banjora	73	Banjora	1492	1.67
2	Banjora	Debagram	66	Debagram	361	3.22
3	Banjora	Jalanpur	74	Jalanpur	982	1.83
4	Kustore	Kustor	26	Kustor	3278	1.50
Total Population					**6113**	**-**

Table 2:Details of Fluoride affected Tube wells in Gangajalghati Block

Sl. Nos.	Name of Gram Panchayat	Total Number of Tube wells	Nos. of Tube wells with Fluoride Concentration	
			1.0 – 1.5 Mg/l	'> 1.5 Mg/l
1	Banasuria	95	27	07
2	Barshal	101	20	02
3	Bhaktabundh	68	01	00
4	Gangajalghati	119	03	01
5	Gobindadham	97	08	01
6	Kapista	34	00	00
7	Lachhmanpur	86	04	00
8	Latia Boni	86	28	05
9	Nityanandapur	95	12	04
10	Pirrabani	95	12	04
Total		**876**	**115**	**24**

Table 3: Fluoride affected Habitation in Gangajalghati Block

Sl. Nos.	Name of Gram Panchayat	Village	JL No:	Habitation	Population	Maxm. Fluoride Conc. (In Mg/l)
1	Banasuria	Beldanga	48	Beldanga	1219	2
2	Banasuria	Bhalukathol	43	Bhalukathole	401	1.67
3	Banasuria	Chhota lalpur	53	Chhotolalpur	655	2
4	Banasuria	Kusthalia	49	Kustholia	1902	2
5	Banasuria	Narayanpur	50	Narayanpur	147	2
6	Banasuria	Ranga metya	61	Rangametya	919	2
7	Barshal	Chausal	14	Radhamadhabpur	1521	1.95
8	Barshal	Srichandrapur	16	Srichandrapur	1243	1.69
9	Gangajalghati	Keshiara	81	Bharatpur	95	2.32
10	Gobindadham	Amjor	98	Khuderdanga	256	1.87
11	Gobindadham	Konra	105	Koro	692	2.75
12	Kapista	Kapishtha	115	Kapista	3242	1.51

Sl. Nos.	Name of Gram Panchayat	Village	JL No:	Habitation	Population	Maxm. Fluoride Conc. (In Mg/l)
13	Latia boni	Nandanpur	41	Amdanga	208	1.78
14	Latia boni	Durlabhpur	33	Durlovpur	1725	1.85
15	Latia boni	Benagari	32	Paruibaid	793	1.58
16	Nityanandapur	Anandapur	19	Anandapur	545	1.67
17	Nityanandapur	Chaitanyapur	21	Chaitanyapuir	902	1.81
18	Nityanandapur	Sibipara	25	Dangapara	669	1.78
19	Nityanandapur	Sibipara	25	Subirara	1521	2.17
Total Population					**18655**	**-**

Table 4: Details of Fluoride affected Tube wells in Indpur Block

Sl. Nos.	Name of Gram Panchayat	Total Number of Tube wells	Nos. of Tube wells with Fluoride Concentration	
			1.0 – 1.5 Mg/l	'> 1.5 Mg/l
1	Bheduasole	128	04	00
2	Brahmandiha	135	05	01
3	Brajarajpur	120	08	01
4	Gourbazar	77	00	00
5	Hatagram	120	13	01
6	Indpur	116	03	00
7	Raghunathpur	123	11	00
Total		**819**	**44**	**3**

Table 5: Fluoride affected Habitation in Indpur Block

Sl. Nos.	Name of Gram Panchayat	Village	JL No:	Habitation	Population	Maxm. Fluoride Conc. (In Mg/l)
1	Bheduasole	Kalpathar	178	Kalpathar	674	7.09
2	Brahmandiha	Padulara	60	Padulara	1560	1.62
3	Brajarajpur	Botkula	156	Botkula	398	1.62
4	Brajarajpur	Gunnath	172	Haridihi	177	4.89
5	Hatagram	Kajalkura	31	Parasiban	58	1.63
6	Hatagram	Uttarpairachall	13	Uttarpairachall	2246	6.4
7	Indpur	Krishnagar	126	Krishnagar	336	1.52
Total Population					**5449**	**-**

Table 6: Fluoride affected Tube wells in Taldangra Block

Sl. Nos.	Name of Gram Panchayat	Total Number of Tube wells	Nos. of Tube wells with Fluoride Concentration	
			1.0 – 1.5 Mg/l	'> 1.5 Mg/l
1	Amdangra	-	-	-
2	Falbibarda	75	06	01
3	Fulmoti	86	01	00
4	Harmasra	125	10	08
5	Khalgram	138	02	02
6	Panchmura	105	04	02
7	Saltora	101	00	00
8	Satmouli	119	01	00
9	Taldangra	56	04	00
Total			**28**	**13**

Table 7: Fluoride affected Habitation in Taldangra Block

Sl. No.	Name of Gram Panchayat	Village	JL No:	Habitation	Population	Maxm. Fluoride Conc. (In Mg/l)
1	Fal bibarda	Harakona	63	Kherisole	175	1.94
2	Fal bibarda	Bibarda	6	Medina	5399	2.11
3	Harmasra	Harmasra	28	Harmasra	2972	3.65
4	Harmasra	Kolsuli	50	Kolsuli	221	1.78
5	Harmasra	Mahishakanali	42	Mahishakanali	117	1.57
6	Harmasra	Marasol	27	Marasole	294	3.33
7	Khalgram	Painada modarpur	18	Agoyauparpara	152	2.32
8	Khalgram	Paika	9	Paika	545	1.57
9	Khalgram	Kadamara	17	Patharkuria	168	9.28
10	Panchmura	Lalbandh	109	Lalbandh	1337	1.94
11	Panchmura	Nutangram	97	Natungram	688	1.66
12	Taldangra	Radhamohanpur	58	Radhamohanpur	607	2.74
				Total Population	**12675**	**-**

Annexure-11: Recommended Re-charge Structures

Table 1: Artificial Re-charge Structure Suitable under Combination of Different Topographic Slope and Hydro-geologic groups

Sl. No	Topographic Slope	Hydro-geologic Group			Aquifer Confined / Unconfined
		Consolidated	Semi-Consolidated	Un-Consolidated	
1	Steep Slope (20% - 10%), Runoff Zone	Bench Terrace, Contour Trench	Bench Terrace Contour Trench	-	Unconfined
2	Moderate Slope (10% - 15%), Piedmont Zone	Bench Terrace, Contour Trench, Gravity Head	Bench Terrace Contour Trench Gravity Head	Ditch & Furrow, Recharge Basin, Pits & Shafts, Contour Trench, Gravity Head Recharge Well	Unconfined
		Deep Gravity Head Recharge Well			Confined
3	Moderate to Gentle Slope (2% – 5%) Transition Zone	Nalah Bunds, Contour Bunding, Percolation Tanks, Recharge Pits, Induced Recharge, Ground Water Dams	Recharge Basin, Induced recharge, Stream Channel, Modification of Recharge Pits	Flooding, Recharge Basin, Stream Channel Modification, Induced Recharge Gravity Head	Unconfined
		Hydro-fracturing			Confined
4	Gentle Slope (<2%), Storage Zone	Recharge Pits Recharge Wells	Recharge Pits		Unconfined

NOTE:

1. The Land Slope in Bankura is in the order of 10 – 20m/km in the Western and Central part and less than 10m/km in the Eastern part.
2. The average annual rainfall in the District varies from 1200mm – 1400m. Rainfall is considered as Adequate, if the annual precipitation is more than 1000mm