Final Writing Assignment

Topic:

Present Hydrological condition of North-24 Parganas District of West Bengal and related water resource management issues

Submitted by

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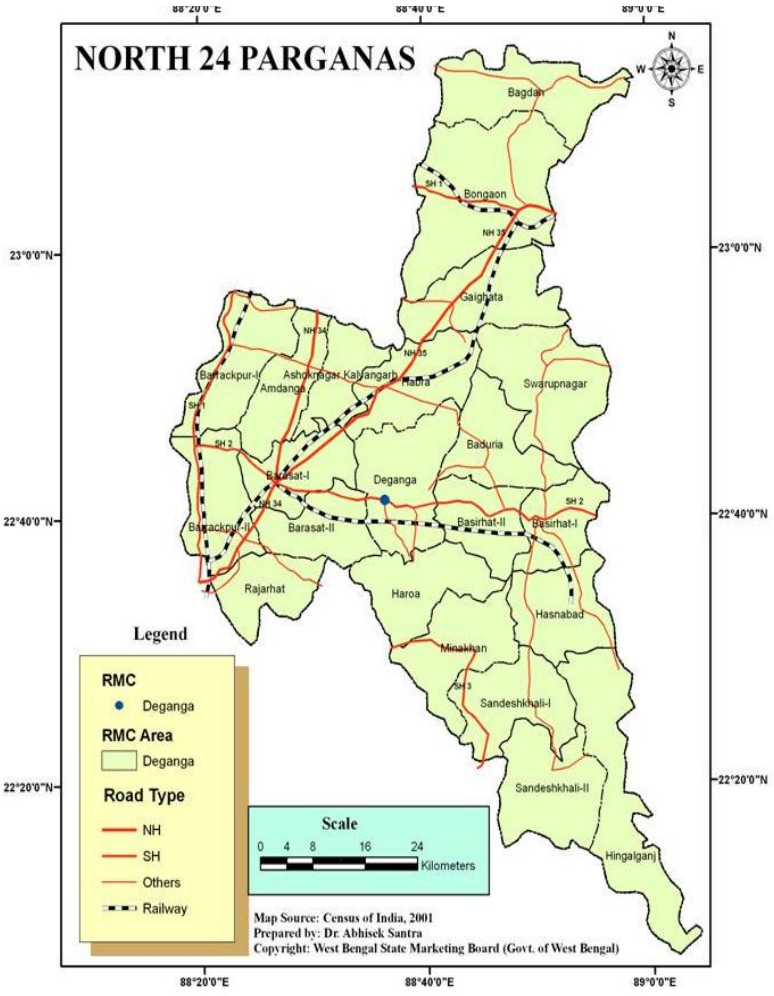
Introduction: Average global surface temperature is increasing with respect to time. Due to spatial and temporal variability of climate one side of a country may face flooding and at the same time another side may have severe drought. With the development of our civilization huge disturbance have been imposed on the nature and as a result many problems like temperature rise, variation of rainfall, decreasing water availability, depletion of ground water table, water pollution etc. In West Bengal 53 nos of blocks have been categorized as Semi Critical and 1 no Block as critical by the CGWB, India. Among them Barrackpore-II Block of North 24 Parganas district is semi critical. In this district the present water resources related problems are, falling trends of ground water table, diminishing surface water availability, arsenic and salinity problem. Management of water resource and its proper allocation is a very important issue nowadays. Adoption of various management practice and mitigation measures can play an important role for sustainable development of water resource of this district.



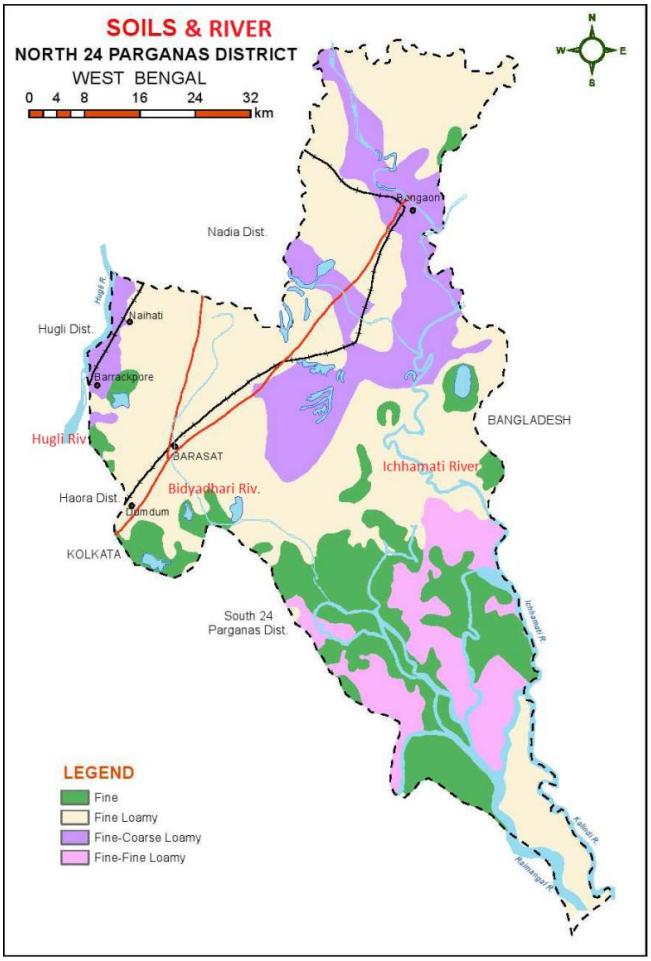


Fig: 1 District map of North 24 Pargans with Block boundary. Fig:2 Soil type and river network of North-24 Pgs.

Geographical position:

This North 24 Parganas District is situated in the upper delta plain of Ganga-Bhagirathi river systems of southern West Bengal. Latitude of this district varies from 23°15'north - 22°11' North and Longitude 89°5'East - 88°20' East in the tropical zone. Geographical area of the district is 4094 Sq km with boundary of Bhagirathi-Hoogly river in west side, Kolkata & south 24 Parganas in southwards, Bangladesh in east and Nadia district in north side. Along with the river Bhagirathi-Hoogly there are many other rivers like Ichhamati, Jamuna, and Bidyadhari. The surface water of river system of this area is mostly affected by salinity problem mainly in Ichhamati and Bidyadhari. Soil types vary widely from alluvial to clay loam with almost flat topography. Geographical position, Block boundary, soil type and river network of this area ie shown in Figure1 & 2.

Hydrological condition: (**Reference to the course**- Runoff process, Flood Frequency Analysis)

Rainfall-

This area receives about 1579 mm of normal annual precipitation. Monsoon in West Bengal generally stretches from June to September. There are mainly four weather seasons prevail in this area i.e. winter (Dec-Feb), summer (Mar-May), monsoon (June-Sep), and autumn (Oct-Nov). About 74% of the total rainfall occurs during monsoon. Summer and autumn also receive some rainfall in this region. Monsoon wind formation starts roughly from end of May to the first week of June and recedes as September heads to a close. Fig. (3 & 4) are showing the monthly and annual variation of rainfall in this district. Trend of the annual precipitation of last 13 years it is clear that after 2007 there was falling trend of annual precipitation up to the year 20010. In the year 2010 drought was declared in this district. After 2010 raising and falling trends in annual precipitation has observed. In the year 2008, 2009, 2010, 2012 and 2014 the annual precipitation was significantly below from the normal precipitation. Spatial and temporal variation of rainfall depends on a number of complex factors some of which are constant or static while others vary from one year to the other. Important among these are : location of the place with respect to moisture bearing monsoon air current, position of land and water, Break in the monsoon and its duration, frequency and movement of depressions and ,formation of other low pressure systems etc.

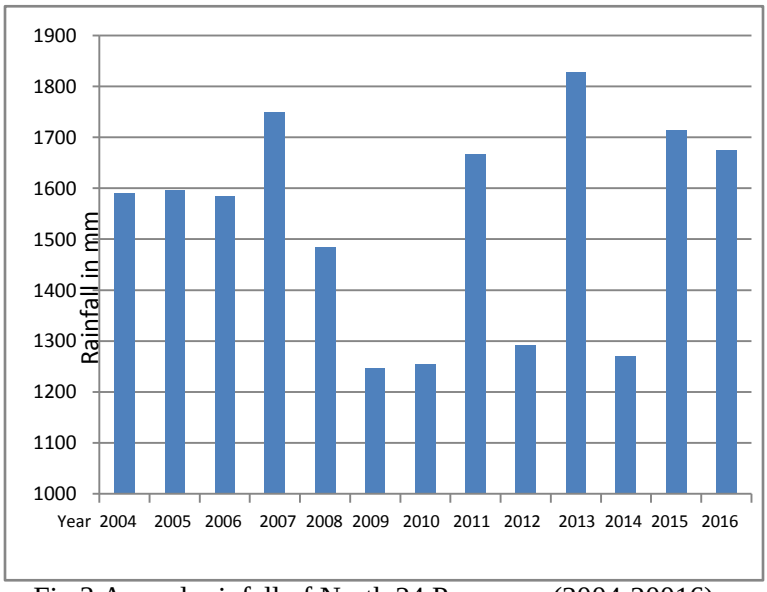


Fig.3 Annual rainfall of North 24 Parganas (2004-20016)
(Rainfall Data Source- IMD)

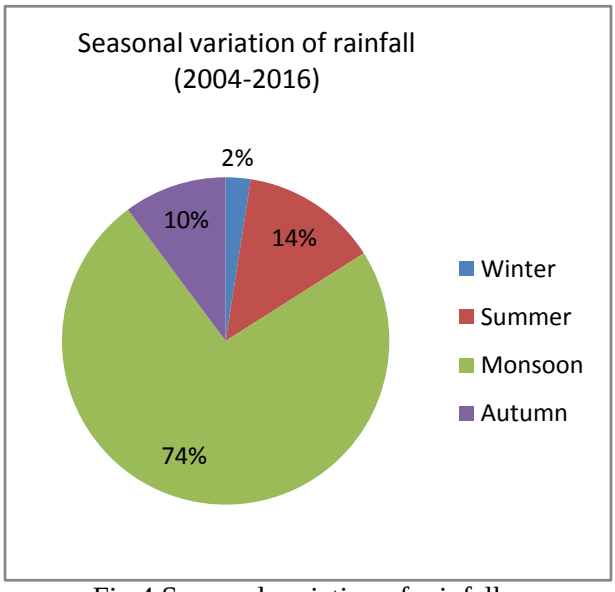


Fig.4 Seasonal variation of rainfall

Cyclone storm-

Party of this district is falling in the costal belt of Bay of Begal hence it is very much susceptible to cyclone storm. In the year 2009 devastating AILA storm occurred and damaged the district severely. Cyclones in this area mainly form during the transitional period of pre-monsoon (April-May) and post monsoon months (October-November). On an average one cyclone during the pre monsoon period and two in the post monsoon period form over the Bay of Bengal every year. These two periods are therefore, known as cyclone season in this part of the country.

Runoff process (occurrence of flooding in this area)-

Key inputs- (i) Significant intensity and the amount of rain fall during monsoon (about 1200 mm)

(ii) Topography – almost flat terrain, land slope very low.

(iii) Soil type- Silty Loam to Clay Loam having low infiltration capacity

(iv) Land use land cover – mostly agricultural land

(v) Nature of river- Ichhamati and Bidyadhari is mostly meandering, Tidal back water flow is there, several breaches of embankment of rivers, siltation of river bed.

(vi) Contribution of discharge from upstream are? - Yes presence in case of Ichhamati.

During rainfall the main losses are interception, depression storage, evaporation and infiltration. As this area is in sub-humid region hence excessive evaporation loss is not seen here. Evaporation loss in summer and dry winter month are more than the rainy monsoon season. Normal daily pan evaporation rate 5.68 mm/day during dry season. Minimum part of this district is drained through Bhagirathi-Hoogly and major part through Ichhamati and Bidyadhari rivers.

Runoff pattern of this area during monsoon period is saturation excess overland flow. But in case highly intense rainfall infiltration excess overland flow is also occurred as the soil of this area has low infiltration rate. From the above it is very clear that the area has delayed response of rainfall runoff process. Flat topography, low infiltration rate, meandering nature of river with longer length and silt deposition in river bed, tidal water backflow etc. are causing poor drainage capacity of the basin area. Due to silt deposition bed level of Ichhamati River is 4 m above than the Mathabhanga river of Bangladesh from where it is generated and thus in lean season no flow enters to Ichhamai from upstream but in rainy season when flood flow enters from upstream it cannot passes easily. For these reasons frequent flooding events are observed in this district. Almost in every year low land area of the following block such as Swarupnagar, Baduria, Gaighata, Bongaon, Haroa, Deganga become flooded. The major flooding years for this district are 1956, 1959,1978,1995,1999 and 2000. Flood in the year 2000 was occurred due to breach of embankment of river in the upstream district of Nadia.

Flood year under consideration	Annual rain fall (mm)	Return Period	Probability of exce. (%)
1956	1809.81	3.64	27.47
1959	1953.63	4.32	23.15
1978	2217.64	21.8	4.58
1999	1842.64	3.7	27.03

Table-1. Return period of major flood years rainfall

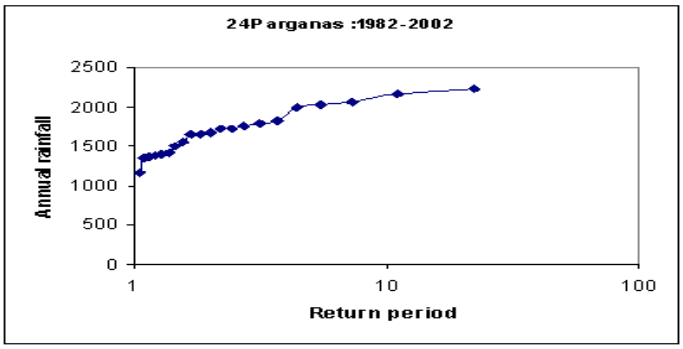


Figure-5 Return period curve of rainfall (1982-2002)

For North-24 parganas the calculation of return period is shown in Fig.5 for the year spanning from 1982 to 2002. The maximum amount of rainfall which occurred during that period was 2235.34 mm (annual value) corresponding to a return period of 22 years and a probability of occurrence of 0.04545 while the minimum rainfall during the period was 1162.56 mm corresponding to a return period of 1.1 years and a probability of 0.9. There are four major flood years are considered that is 1956, 1959, 1978, 1995 whose annual rainfall were 1809.81 mm, 1953.63 mm, 2217.64 mm and 1842.64 mm. Their return periods are calculated with the aid of graph of Fig-5 and shown in the Table-1.

Condition of Ground water and surface water:

Ground water resource of this area is presently under stress in terms of quantity and quality also. Depletion of ground water table is common phenomenon for this area Stage of ground water development is 62 %. Ground is the main source of irrigation of this area. Huge numbers of ground water irrigation schemes like Deep Tube Well 373nos, Light Duty Tube Well 372 nos, and Shallow Tube Well 253(except privet own). During Irrigation in Boro season many area of this district face the problem of lack of water in shallow tube well. The main problem of river water in this area is salinity, as the river system of this area is tidal in nature hence intrusion of saline sea water in river as well as aquifer is a common problem for the coastal part of this area. Out of 22 Blocks of North 24-Parganas ground water of 20 nos of Blocks are Arsenic affected. Ten numbers of Blocks are affected by chloride contamination in ground water or surface water. About 35.63 lakhs people out of the total population of 35.85 lakhs are in the risk zone of arsenic pollution. Arsenic in ground water of this area is mainly restricted in shallow aquifer (depth 15 to 80mbgl) which is mainly built up of sediments deposited by meandering streams and levees. The deeper arsenic free aquifer (l00-350m) is separated from upper arseniferrous aquifer by a thick clay bed. Details of present condition of Ground and Surface water are furnished in the Table-2.

Sl. No.	Name of Block	Ground Water			Surface Water	Remarks (Block affected by)
		Maximum WL fall in m (April-2012-April 2013)	Arsenic Concentration (mg/ L)	Chloride in Concentration (mg/ L)	Chloride in Concentration (mg/ L)	
1	Amdanga	2.12	<0.005 –0.25	14-28	No data	As
2	Baduria	1.7	<0.005 – 0.25	35-128	70-90	As
3	Barasat-I	1.85	<0.005– 0.25	21-71	270-350	As & Cl
4	Barasat-II	1.7	<0.005– 0.30	21-28	70-80	As
5	Barrackpore-I	1.1	<0.005 –0.10	14-21	30-60	As
6	Barrackpore-II	No data	<0.005 –0.01	No data	40-60	As
7	Basirhat-I	0.95	<0.005 –0.25	28-128	450-920	As & Cl
8	Basirhat-II	0.80	<0.005 –0.25	14-28	No data	As
9	Bagdah	0.70	<0.005 –0.25	21-35	50-60	As
10	Bongaon	1.9	<0.005 –0.25	14-121	60-250	As
11	Deganga	0.95	<0.005 –0.44	14-50	80-90	As
12	Gaighata	2.32	<0.005 –0.50	21-596	210-660	As & Cl
13	Habra-I	2.18	<0.005 –0.37	14-43	270-340	As & Cl
14	Habra-II	2.22	<0.005 –0.25	14-43	60-70	As
15	Haroa	2.20	<0.005 –0.40	21-364	140-360	As & Cl
16	Hasnabad	1.9	<0.005 –0.25	43-1134	820-1080	As & Cl
17	Higalganj	No data	Below DL	No data	1220-2420	Cl
18	Minakhan	1.39	<0.005 –0.10	44-135	230-340	As & Cl
19	Rajarhat	2.6	<0.005 –0.25	35-440	No data	As
20	Sandeshkhali-I	1.8	<0.005 –0.01	43-57	310-1900	As & Cl
21	Sandeshkhali-II	2.6	Below DL	71-213	No data	Cl
22	Swarupnagar	0.5	<0.005 –0.50	57-71	60-680	As

Table No-2 Status of Ground/surface water ***Source –SWID WB***

Management issues of water resources:

Considering the present hydro-geological condition of this area good management practice of water resource is most important issue nowadays. The Govt. of West Bengal has already enacted West Bengal Ground Water Resources (Management, Control and Regulation) Act, 2005 by which withdrawal of Ground water has been regulated. In the report of CGWB -2012 has shown that this district is falling in the area of priority for artificial ground water recharging. The following management practices are to be adopted for this area.

Aquifer management and artificial recharging- Block wise aquifer mapping is required for selection good water bearing aquifer in order to ensure good drinking water for the people of this are. As deeper aquifer of this area is almost free from arsenic contamination hence, while installing deep tube well appropriate sealing of aquifer is very important for preventing movement of contaminant between the water bearing layers. Annual replenishable ground water recharge rate for this are is very less (ie. < 0.1m/year). Hence implementation of artificial recharge technique in this area can play a good role for augmentation of ground water. Recharging can be done through recharge well, recharge pit, abandoned tube well/dug well, percolation tank etc. Sufficient recharge to ground water can raise ground water table, dilute concentration of contaminants and thus ensures availability water for our future generation.

Rain water harvesting-This area has immense potential of rainwater harvesting as this area receives annually about 1500 -1600 mm of rainfall. Rain water harvesting in this area can be doe in many ways like excavating water harvesting tank, re-excavating existing water bodies i.e. enhancing water storage capacity, creating poly /Geo-membrane lining community based water harvesting tanks. This rain water can be used in irrigation, fisheries, and household purpose and thus withdrawn of ground can be minimized. Ground ware recharge also increase through deep percolation (Fig-7) of this harvested rainwater. By increasing water harvesting capacity flooding of some area can be managed.

Micro-irrigation technique- This modern technique of irrigation requires less water as compared to other conventional methods due to its higher application efficiency. Micro-Irrigation such as Drip (Fig-6) and Sprinkler techniques can be adopted for this area. About 35-40 % of water can be saved by this method and also application of fertilizer and pesticides with this irrigation water can be done. More over due to good management of root zone moisture content by this method yield and quality of products also enhanced. If considerable area can be covered under irrigation method significant amount of ground water withdrawn can be minimized.

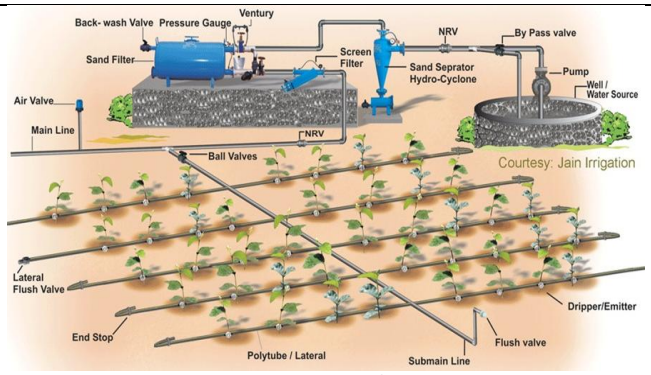


Fig-6 Schematic Diagram of Drip Irrigation

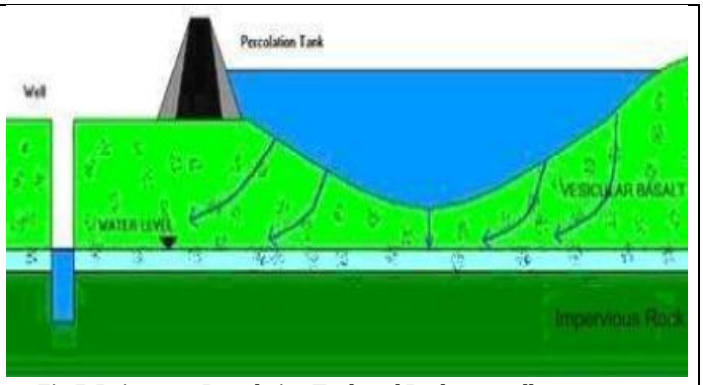


Fig-7. Rain water Percolation Tank and Recharge well

Concluding summary-Significant variation in hydrological condition of Northa-24 Parganas district of West Bengal has been observed. Arsenic in ground water is a threat for this district. Transmission of arsenic to the people of this area is causing not only through drinking but also trough agricultural products. Ground water table depletion and sea water intrusion in coastal area are also a bad implication to the water resource of this district. To alleviate problem of flooding de-siltation of river Ichhamati and Bidyadhati is needed. To alleviate these problems, implementation of Ground Water act-2005 in conjunction with mitigation measures such as Aquifer management and artificial recharging, Rain water harvesting, Micro-irrigation technique can play a key role for sustainable development of water recourse of this area.

Reference:

1. Aquifer systems of India, CGWB-2012
2. Dynamic ground water resources of india, CGWB- 2014
3. Annual Flood report 2016, Govt of West Bengal.
4. Rainfall Statistics of India- IMD
5. DL Course in Hydrology- modules(Runoff process, Flood frequency analysis)