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Identifying the Causes of Water Scarcity in Purulia, West Bengal, India - A Geographical perspective

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Abstract: *Water scarcity is one of the most important concern of present day geographers as water is the central subject of all kinds of developmental activities. Water is essential for all socio-economic development and for maintaining a healthy ecosystem in the world. At present reduction of water scarcity is prime goal of many countries and governments. Purulia is one of the most backward district of West Bengal in terms of economic and human development and also it has the second largest schedule tribe population. Water scarcity is a regular threat for the people of Purulia district which has a great negative impacts on development of Purulia. So it is very crucial to free the people of Purulia from this curse of water scarcity. For this purpose the present paper has been designed for the identification of root causes of water scarcity of Purulia .But it is impossible to reduce the present day scenario of water scarcity of Purulia without investigating the true causes of water scarcity for further water resource management planning of the district.*

Keywords: *Anthropogenic, Geology, Hydrometeorology, Socio-economic development, Water Scarcity*

I. Introduction

Human security means having protection against unpredictable events that disrupt lives and livelihoods. Few resources have a more critical bearing on human security than water. As a productive resource, water is essential in maintaining the livelihoods of the world's most vulnerable people. But water also has destructive properties, as witnessed by storms and floods. Security in access to water as a productive input and protection against the vulnerabilities associated with uncertainty of water flows is one of the keys to human development(HDR,2006).

70% of the earth surface is covered with water, which amounts to 1400 million cubic kilometres (m km3). However, 97.5% of this water being sea water, it is salty. Fresh water availability is only 35 m km3. Out of the total fresh water, 68.7% is frozen in ice caps, 30% is stored underground and only 0.3% water is available on the surface of the earth. Out of the surface water, 87% is stored in lakes, 11% in swamp and 2% in rivers. As all the sweet water is not extractable, only 1% of the total water can be used by human beings (Anon. 2006).

Water scarcity is the lack of sufficient available water resources to meet the demands of waterusage within a region. It already affects every continent and around 2.8 billion people around the world at least one month out of every year. More than 1.2 billion people lack access to clean drinking water(International Decade for Action Water for Life-2005-2015).

Water scarcity is a relative concept and can occur at any level of supply and demand. Scarcity may be a social construct(a product of affluence , expectations and customary behaviour) or the consequence of already supply patterns stemming from climate change. Scarcity has various causes most of which are capable of being remedied or alleviated. A society facing water scarcity usually has options. However , scarcity often has its roots in water shortage and it is in the arid and semi- arid regions affected by droughts and wide climate variability, combined with population growth and economic development, that the problems of water scarcity are most acute(UN-WATER,2006).

Water is the most important natural resource and is vital for all life on earth. The well-being and the development of our society is dependent on the availability of water. This most precious resource is sometimes scarce sometimes abundant and is always very unevenly distributed , both in space and times(Reddy,2011).

Though in general the main causes of water scarcity are climate change accompanied with high temperature, low precipitation and loss of vegetation cover but every geographical area should have some inborn causes related to its origin, structure, geographical location and setup. Purulia is one of the most backward district of West Bengal and highly dependent on rural economy. But water scarcity is a regular phenomenon of Purulia. Water development is linked closely with poverty reduction especially in low income countries that are highly dependent on rural economy(UN-WATER,2006). So it is very essential to identify the causes of water scarcity of the district like Purulia which is totally dependent on rural economy for the socio-economic development of the district as water plays a significant role in economic and human development. That's why the present paper is nothing but a useful effort to identify the root causes of water scarcity of Purulia district in West Bengal, India.

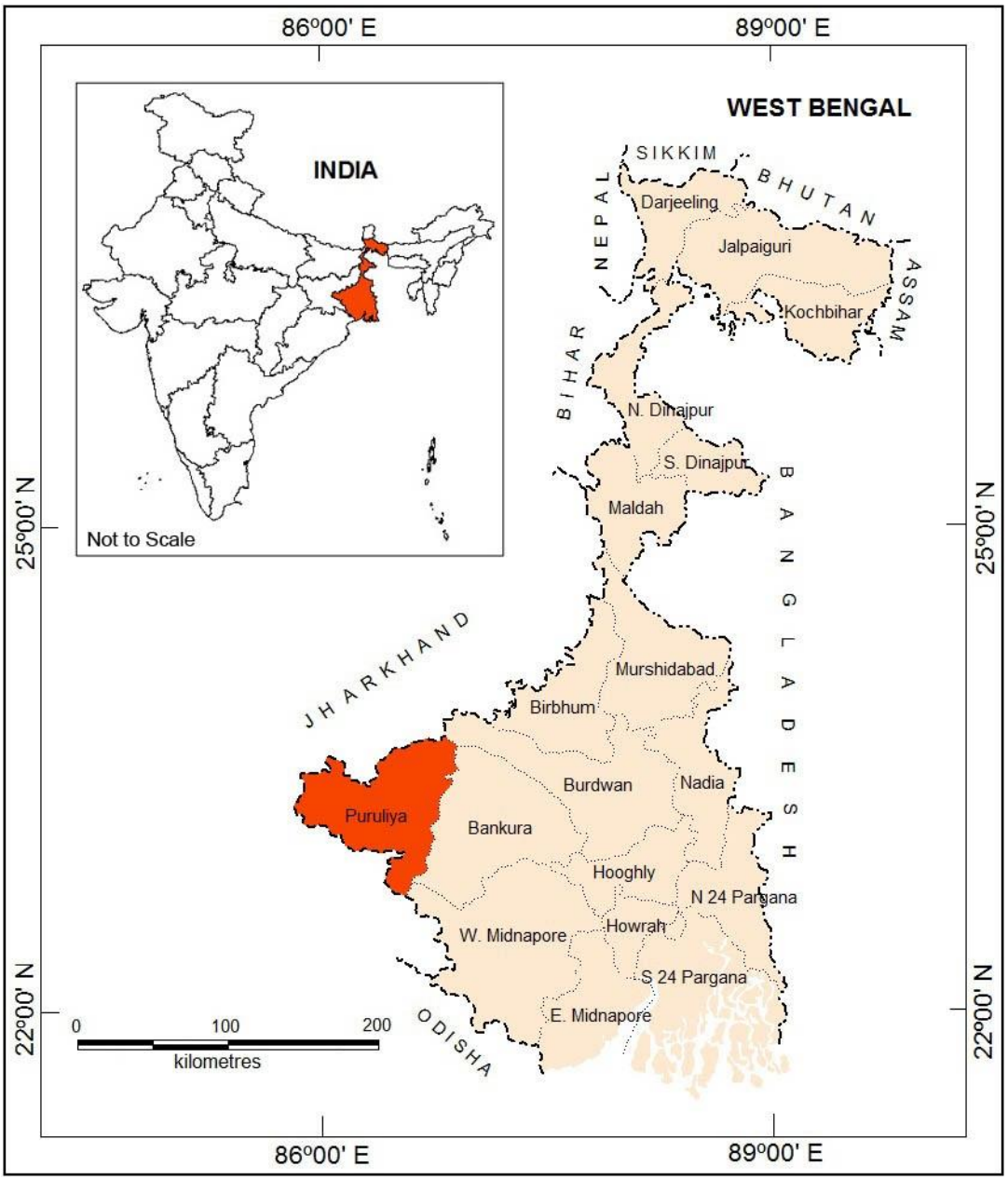
II. The study area

JainaBhagavati Sutra of circa 5th century A. D. mentions that Puruliya was one of the 16 Mahajanapadas and was a part of the country known as Vajra-bhumi in ancient times. However, little was known about Purulia before the East-India Company obtained the 'Diwani' of Bengal, Bihar, Orissa in 1765. By regulation XVIIII of 1805, a Jungle Mahals district composed of 23 parganas and mahals including the present Purulia was formed. By regulations XIII of 1833 the Jungle Mahals district was broken up and a new district called Manbhum was constituted with headquarters at Manbazar. The district was very large in size and it included parts of Bankura, Burdwan of present West Bengal and Dhanbad, Dhalbhum, Saraikela and Kharswan of present states of Jharkhand and Orissa. In 1838 the district headquarters was transferred to Purulia as is known today. Finally in 1956 Manbhum district was partitioned between Bihar and West Bengal under the States Reorganization Act and the Bihar and West Bengal (Tranfer of Territories) Act 1956 and the present district Purulia was born on 1st November, 1956(W.B, district gazetters, Purulia,1985).

Purulia is the western most district of West Bengal with all India significance because of it's tropical location , it's shape as well as function like a funnel. It funnels not only the tropical monsoon current from the Bay to the subtropical parts of north-west India, but also acts as a gateway between the developed industrial belts of West Bengal and the hinterlands in Orissa, Jharkhand, Madhya Pradesh and Utter Pradesh. Geographically the district is located in between 22˚42'35" and 23˚42'0" north latitude and 85˚49'25" and 86˚54'37" east longitude. Purulia has hardly any natural boundary demarcated by streams or hills. Only about a hundred kms of the district boundary follows the Damodar in the north and the Subarnarekha in the west. The artificial district boundary is mainly an outcome of linguistics regionalization and administrative convenience . Purulia has its boundaries on the east with Midnapore and Bankura districts of West Bengal ; on the north Burdwan district of West Bengal and Dhanbad district of Bihar; on the north west and south west with the Hazaribag, Ranchi and Singbhum districts of Jharkhand.

The land shape of Purulia is quite unique having distinctive soil, terrain, drainage , forest and whole gamut of physical environmental setup which is within the ambit of Rarh tract of West Bengal. At present the district has 20 CD blocks, 170 Gram Panchayats , 2683 Mouzas and 2687 villages and 7 towns. Purulia has a long history of water scarcity which had been illustrated in numerous folksongs i,eTusu, Vadu, Jhumur etc an folklores(Gangopadhaya,2003). Purulia is one of the most backward district of W.B. in terms of economy and human development. Notably the district has the second highest concentration of schedule tribe (S.T.) population in W.B.(Census,2011) and agro-based economy. Purulia is very rich in its wealth as well as cultural heritage . This is a place where we can observe the culture of Bengal, Bihar (recent Jharkhand) and Orissa are in harmony.

LOCATION OF THE STUDY AREA



III. Present status of global water scarcity

Water use has been growing at more than twice the rate of population increase in the last century and although there is not global water scarcity as such, an increasing number of regions are chronically short of water. By 2025, 1800 million people will be living in countries or regions with absolute water scarcity, and two -thirds of the world population could be under stress conditions. The situations will be exacerbated as rapidly growing urban areas place heavy pressure on neighbouring water resources(UN-WATER,2006).

Hydrologists today typically assess water scarcity by looking at the population-water equation. This is done by comparing the amount of total available water resources per year to the population of a country or region. A popular approach to measuring water scarcity has been to rank countries according to the amount of annual water resources available per person. For example, according to the Falkenmark Water Stress Indicator, a country or region is said to experience "water stress" when annual water supplies drop below 1,700 cubic metres per person per year. At levels between 1,700 and 1,000 cubic metres per person per year, periodic or limited water shortages can be expected(Falkenmark and Lindh,1976). When water supplies drop below 1,000 cubic metres per person per year, the country faces "water scarcity" and below 500 cubic metres , " absolute scarcity"(Larsen,Samuel,2009). The United Nations' FAO states that by 2025, 1.9 billion people will be living

in countries or regions with absolute water scarcity, and two-thirds of the world population could be under stress conditions(FAO,2013). The World Bank adds that climate change could profoundly alter future patterns of both water availability and use, thereby increasing levels of water stress and insecurity, both at the global scale and in sectors that depend on water(The World Bank,2009).

Today about 700 million people in 43 countries live below the water- stress threshold. With average annualavailability of about 1200 cubic metres per persons the Middle East is the world's most water stressed regions ; only Iraq, Iran, Lebanon and Turkey are above the threshold. Palestinians , especially in Gaza , experience some of the world's most acute water scarcity - about 320 cubic metres per persons. Sub-Saharan Africa has the largest number of water stressed countries of any region. Almost a quarter of Sub-Saharan Africa's population lives in a water-stressed country today - and that share is rising(HDR,2006).

According to the future projection done by UNDP as Human Development Report , 2006 , by 2025 more than 3 billion people could be living in water-stressed countries - and 14 countries will slip from water stress to water scarcity. Developments to 2025 will include:

- Intensifying stress across Sub-Saharan Africa, with the share of the region's population in water stressed countries rising from just above 30% to 85% by 2025.
- Deepening problems in the Middle East and North Africa , with average water availability falling by more than a quarter. By 2025 average water availability is projected to be just over 500 cubic metres per person, and more than 90% of the region's people will be living in water-scarce countries by 2025.
- High population countries such as China and India entering the global water-stress league.

IV. Water scarcity of India

Approaching of the summer in India, brings water crisis with it, wells, ponds and taps dry up, women begin to walk the village streets and city roads with pots and pitchers looking for water point. The municipality water tankers and government run water trains begin to traverse the length and breadth of the country, people gather on streets corners , village squares and in front of municipality offices. Protests, demonstrations , road blockades, take place. City dwellers go against farmers, villagers against towns , towns against cities and citizens against government, people against people. Increasingly , these conflicts are taking on general shape of a bitter war for water(Sinha,2009).

Although, India is not a water poor country, due to growing human population, severe neglect and over-exploitation of this resource, water is becoming a scarce commodity. India is more vulnerable because of the growing population and in-disciplined lifestyle. This calls for immediate attention by the stakeholders to make sustainable use of the available water resources. The thirst of water for India's rapid development is growing day by day. In spite of adequate average rainfall in India, there is large area under the less water conditions/drought prone. There are lot of places, where the quality of groundwater is not good. Another issue lies in inter-state distribution of rivers. Water supply of the 90% of India's territory is served by inter-state rivers. It has created growing number of conflicts across the states and to the whole country on water sharing issues.

Table-1: Per capita water availability of India

Year	Population (Million)	Per capita water availability (m3/year)
1951	361	5177
1955	395	4732
1991	846	2209
2001	1027	1820
2025	1394	1341
2050	1640	1140

Source:*Government of India,2009*

In 1951 the per capita availability of water in India was about 5177 m3. This has now reduced to about 1545 m3 in 2011(Water resources division, TERI).The demand for water in India is steeply increasing because of the following reasons (Amarasinghe, *et al.* 2007):

- The primary reason is population as India's population which was 1.3 billion in 2005 is expected to rise to 1.66 billion in 2050.
- There is also going to be a major impact on development in the form of urbanisation. In 2007, 28.2% of the Indian population was living in urban areas and the urban population is expected to increase to 55.2% by 2050.
- The per capita income of Indians will increase from $468 in 2007 to $6735 in 2050.
- Increased industrialisation will demand more water as its contribution to GDP will increase from 29.1% in 2000 to 40% by 2050. Thus, the demand for water will increase from 30 billion m^3 in 2000 to 161 billion m^3 in 2050.

- The agriculture development will be more on water intensive cash crops and there will be 80% increase in the demand for water by 2050.

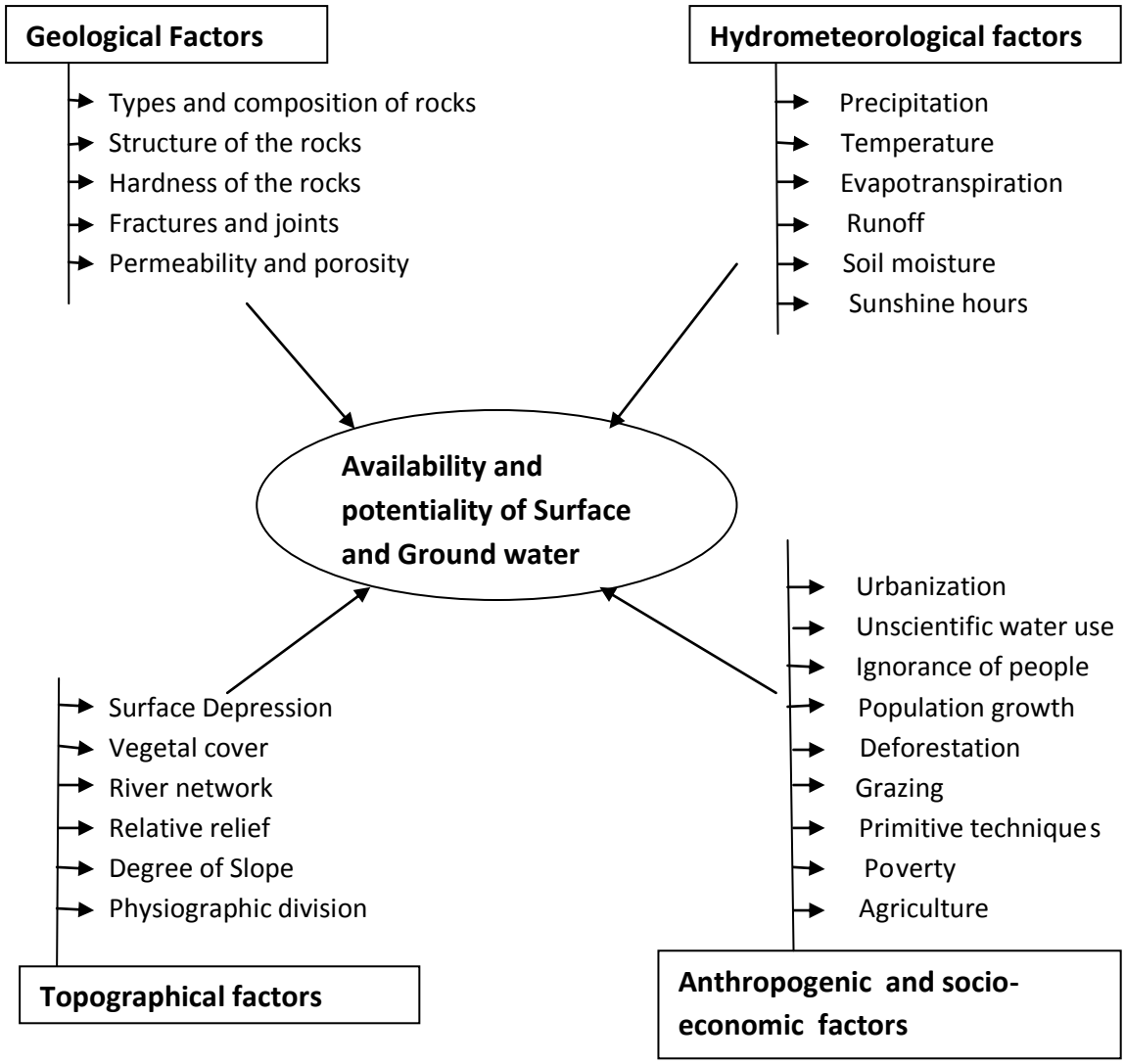
It is therefore necessary to address the bottlenecks affecting the water supply in India.

V. Causes of water scarcity of Purulia

Purulia has a long history of water scarcity. Every year in summer in Purulia village women begin to walk along the village streets with earthen pots and pitchers looking for water. There are several factors which are mainly responsible for the water scarcity of Purulia. Recently the gap between demand and supply of water is widening day by day due to rapid growth of population.

Both physical and economic water scarcity are observed in Purulia. Physical water scarcity is inadequate water resources to meet a country's or regional demand, including the water needed to fulfil the demand of ecosystems to function effectively(UNDP,2006).Arid regions frequently suffer from physical water scarcity. Economic water scarcity is caused by a lack of investment in infrastructure or technology to draw water from rivers, aquifers or other water sources, or insufficient human capacity to satisfy the demand for water.

Fig**: Major factors of availability and potentiality of Surface and Ground water of Purulia**



A) Geological factors:

Ground water potentiality and availability of any region depends on the geologically controlled aquifer system of the region. The geological regions of India broadly follow the physiographic features and may be grouped into three regions: Himalayas and their associated group of mountains, the Indo-Ganga plain and Peninsular Shield. The district Purulia falls under the category of Peninsular Shield. The Peninsula is a region of relative stability and occasional seismic disturbances. Highly metamorphosed rocks of the earliest periods, dating back as far as 380 crore years, occur in the area, the rest being covered by the coastal bearing Gondwana formations, lava flows belonging to the Decan trap formation and younger sediments (India reference annual,2011).

Regionally the area is a part of Chhotanagpur Gneissic Complex(CGC) of Eastern Indian Peninsular Shield, lying to the north of Singbhum Craton. Dunn &Dey(1942) first described the complex as largely a product of replacement origin.Geologically, Purulia district of West Bengal is dominated primarily by granite gneiss rocks. Proterozic hard granite gneiss and migmatite are the principal rock types found in Manbazar while Proterozic soft, flaky phyllite and mica schist belonging to the Singhbhum Group, composed of quartz, muscovite and biotite mica, are the dominant rocks in Banduan area. Geological set up of Purulia district shows that the district is underlain by Pre-Cambrian Metamorphic except in some parts of northeast where Gondwana sediments predominate. Unconsolidated sediments of recent or sub-recent age are found as narrow stretches along the major river courses. Granite and granite-gneisses are most common rocks with widespread occurrence in the district into which metabasicsoccure as intrusive(CGWB,2006). The rock types other than granite gneiss are amphibolites, mica schist, quartzite, quartz vein, calc- silicate rocks with inter banded crystalline limestone. The upper surface of the district is composed of thin soil cover followed by crystalline massive metamorphic rocks of very high resistivity. Metamorphic rocks are also exposed on the surface at several locations (Sharma, 2005). Purulia has a thick Stratigraphic succession of mostly Archacan granite gneiss (table-1) and to a much lesser extent, Quaternary semi consolidated sediments, Permo Carboniferous sandstone shale, Pre Cambrian massive granites and quartzite and with Recent alluvium sediments deposition (figure-2). Mineralogically these rocks are composed mainly of quartz, feldspar, muscovite, biotite, illite and kaolinite.

The study conducted by the Central Ground Water Board in Puruliya district shows that ground water occurs in Puruliya within four distinct zones, i.e. (i) weathered mantle, (ii) saprolitic zone, (iii) fractured zone of hard rock and (iv) zone of unconsolidated sediments.

The weathered Mantle varies in depth in different parts of the district and its maximum thickness reaches up to 25 meters. Ground water occurs in water table conditions and predominantly developed by open dug wells. In some places these wells become dry in dry summer season. Water yielding capacities are low and restricts within 2.75 liters per second (lps).

The saprolitic zone is sandwiched between weathered mantle and un-weathered granitic rocks. Depth of this zone ranges between 10 – 30 mts. below ground level (mbgl). Average

thickness of this zone is 4 mts. Ground water occurs in semi confined conditions that can yield water at a rate of 2.5 lps. Drawdown in the wells tapping this zone is much less and recovery is quite fast.

In the hard crystalline rocks ground water occurs in saturated fractures situated well beneath the ground. The occurrences of these fractures are generally restricted to 50 – 110 mbgl. Fractures, that are of shallower depths generally occur at 50 – 60 m depth and tapped mainly by borewells fitted with hand pumps, yield water at a rate below 1 to 2.77 lps. Deeper fractures are found at 100 to 110 m depth. Yielding capacity of this zone in Manbazar is 3 lps. In Gondwana sediment zones, fractures are encountered at 103 m depth. They are located within the depth of 24 to 36 mbgl and are capable of yield water at 3.3 – 5.5 lps.

Along the river valleys, stretches the zone of unconsolidated sediments in 5 to 13 mbgl level. This narrow zone varies in thickness and its areal extent is limited within 1 – 2 k.m. across the valley. Saturated thickness of alluvial tract varies from 1 m to 5.5 m. Water yielding capacity of this zone is medium. Open dug wells and shallow tube wells can yield 20 m3 of water per hour for a considerable period of time.

From the above discussion it is clear that geological set up of Purulia has a great contribution in water scarcity as it constraints the ground water development in the following manners-

a)Underlain granitic-gneissic hard crystalline rocks forms constraints in water percolation, thus restricts the water table formation. b) Seasonal fluctuation of water level in the aquifers is common in Puruliya, general trend being the post monsoon rise. 6. Yielding capacity of the aquifers in most blocs of Puruliya district is poor. c) Only the aquifers in Gondwana sediments, in the northern blocks possess considerable water yielding capacity.

Table -2: Stratigraphic succession of PuruliaDistrict(Adopted from Geological Survey of India)

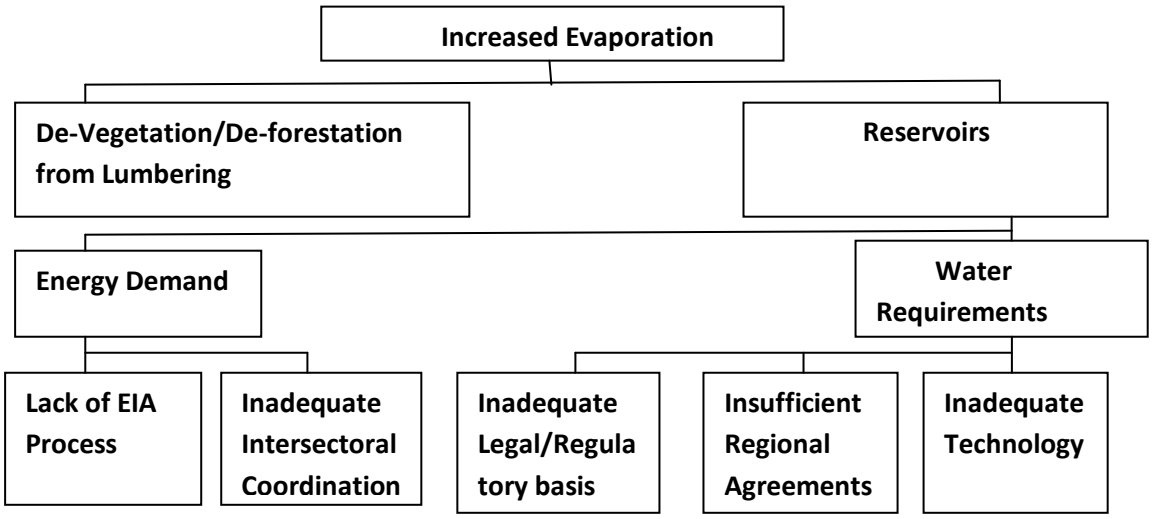
Formation	Age	Lithology	Hydrogeology
Recent alluvium	Recent	Semi consolidated sediments consisting of conglomerates, lateritic and gravel beds	Aquifer is shallow and unconfined. Yield is 5000, to 7000 lph
Sijua formation	Quaternary	Semi consolidated sediments consisting of gravel bed and conglomerate	Aquifer is shallow and unconfined. Yield is 5000, to 7000 lph
Gondwana rocks	Permo Carboniferous	Sandstone shale and coal seams	Sandstone act as minor aquifer Secondary aquifer developed with the fracture zone and cracks and fissures. Average yield is 8000 to 10000 lph
Quartzite and Pegmatite, Granite	Pre Cambrian	Massive Granites and pegmatite and quartzite veins	Secondary aquifer developed at the capping and on the weathered resideum. Cracks and fissures developed in the rocks act as a minor store of groundwater. Aquifer is shallow and unconfined. Yield is 500, to 700 lph
Meta volcanics Meta basics Phyllite and Mica Schiest Granite -gneiss Calc Granulites Mica Schiest	Archean	Rock types belong to Chhotanagpur gneissic complex. Granite gneiss with quartz veins and pegmatite veins. Muscovite and biotiteschiest, highly foliated	Secondary aquifer developed at the capping and on the weathered resideum. Cracks and fissures developed in the rocks act as a minor store of ground water. Aquifer is shallow and unconfined. Yield is 500, to 7000 lph

B) Hydrometeorological factors:

A broader definition of hydrometeorology was given by the World Meteorological Organisation(WMO fourth Congress-1963) in stating that hydrometeorology is concerned with the interrelationship involved(Reddy,2011). Hydrometeorological data are required to determine the water balance of a basin for developing and managing its water resources. The most useful hydrometeorological elements are precipitation, evaporation, solar radiation(sunshine hours), air temperature and humidity, soil moisture, water levels(surface and underground), stream discharge, water quality etc(Raghunath,2014).

Both ground and surface water availability and potentiality of any region is highly determined by these hydrometeorological factors. The Purulia district of West Bengal is not an exception. The main hydrometeorological factors which have great influence on water scarcity of Purulia are runoff, air temperature, evapotranspiration, precipitation and soil moisture.

WATER SCARCITY(*Causal Chain Analysis*)



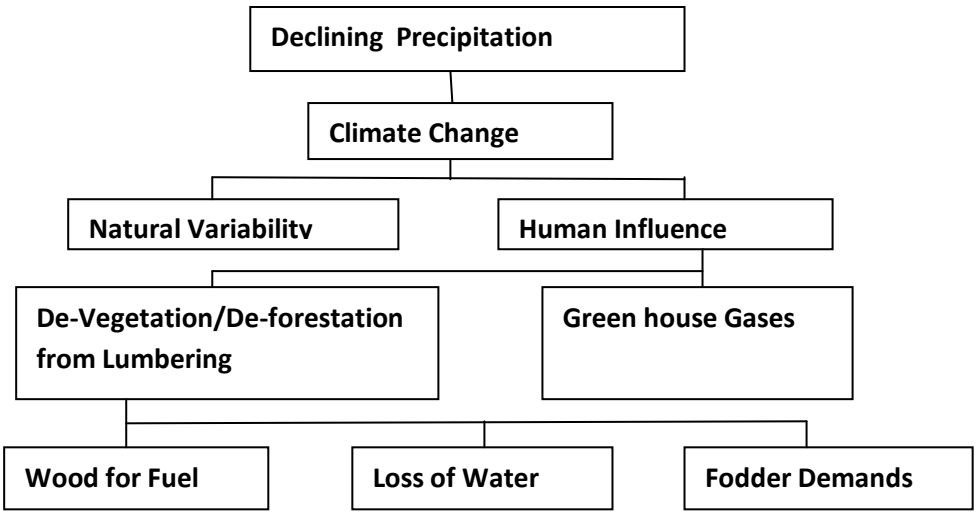
The district is characterized by undulating topography with rugged hilly terrains in the western and southern parts. General elevation of the land surface ranges from 150 m to 300 m, the master slope being towards the east and south-east.In the eastern and south-eastern part of the district the slope ranges between 10

to 20 m/km. In the central part of the district the slope in less than 10m/km and forms a depression. In the western part the slope is higher and ranges from 20-80m/km. As a result of undulating topography the maximum amount of precipitation which is the main source of water input transfers from the district boundary to the surrounding regions as surface runoff which ultimately creates a situation of water shortage.

High rate of evapotranspiration is another important causes of water scarcity of Purulia. The district has the sub-tropical climate which is characterized by hot summer accompanied with high evaporation and transpiration which ultimately generates a high rate of evapotranpiration . As evapotranspiration is a main source of water loss so its results water scarcity.

Temperature also has a great influence on water scarcity of Purulia. Temperature is very high in summer and low in winter- it varies from 7C in winter to 52C in summer, causing dryness of surface water bodies and soil moisture. Maximum water bodies of Purulia dry up in summer season which is the main causes of summer water crisis.

WATER SCARCITY(*Causal Chain Analysis*)



The average annual rainfall varies between 1100mm and 1500mm but it is very irregular in character as south west monsoon is the main source of rainfall. Relative humidity is high in monsoon season, being 75% to 85%. In hot summer it comes down to 25% to35%. Though the rainfall is not so less from the context of climate but it is not sufficient for the district as maximum amount goes outside as runoff and evapotranspiration.

C) Topographical factors:

Topographically the district is characterized by undulating topography with rugged hilly terrains in the western and southern parts. General elevation of the land surface ranges from 150 m to 300 m, the master slope being towards the east and south-east. According to the structure and land form, Purulia happens to be a part of the Ranchi peneplains and this physical character is so dominant that the Government of India has classified this physiographic unit as an economic region. The Purulia is covered by several hill systems specially residual and isolated hills which are responsible for high runoff.

The important hills of Purulia are Ajodhya hill, Joychandi hill and Panchakot hill.The area of Ajodhya Hills is about 320 SqKilometer which covers portions of Jhalda, Baghmundi, Balarampur and Arsha Blocks in Purulia district. The height of Ayodhya Hill is about 2200 feet. The shape of Ayodhya Hills is somewhat L-shaped covering 32 miles in length and 10 miles in width.Panchakot Hill is familiar as a Panchet Pahar. Panchakot was atraditional and historical Hill which was situated in Nituriya Block of Purulia district. The height of the Panchakot Hill is about 2110 feet. Garpanchakot is located beside the base of Panchakot Hill. Joychandi hill is located at Raghunathpur block. The average height of the hill is about 1045 feet(Sengupta, 2002).

The master slope of the district is towards the east and south-east. . In the eastern and south-eastern part of the district the slope ranges between 10 to 20 m/km. In the central part of the district the slope in less than 10m/km and forms a depression. In the western part the slope is higher and ranges from 20-80m/km.

From the above discussion it is clear that the topographical factors like high degree of slope, undulating terrain have a great influence on water scarcity of Purulia causing high rate of runoff.

D) Socio- Economic and Anthropogenic factors:

There are several socio-economic and anthropogenic factors like poverty, population growth, ignorance about the water resource, unscientific use of water, grazing, deforestation, agriculture, primitive method of ground water withdrawals etc which play a significant role in water scarcity of Purulia.

Purulia is one of the most backward district of West Bengal. Most of the block of Purulia comes under the backward class and the district is dominated by S.T. population. Agriculture is the principal source of livelihood in Purulia district. Almost 70 percent of the working population gets engaged in agriculture either as cultivators or as agricultural labourers. A large portion of the district's income comes from the agricultural sector. While the labour participation ratio in the field of agriculture is significantly high, the average income of cultivator is very low for which there is a poor progress of agricultural development. So poverty is everywhere in the district. As a result people of Purulia can't adopt with the modern scientific ground water withdrawals techniques which causing low utilization of ground water. Only 13.78% of the net groundwater reserve is being utilized at present. Thus a huge potential is left out untouched.

The rising trend of population growth is one of the major factor of water crisis in Purulia. The present population can't cope up with the unchanging surface and ground water.

Table-4: Ground water utilization Blocks of Purulia

Ground water utilization Classes	**Name of the Blocks**
Very low(below 300 ham)	Arsha, Bandwan, Manbazar-II, Neturia, Raghunathpur-II, Santuri.
Low(300-599 ham)	Baghmundi, Balarampur, Barabazar, Hura, Jhalda-II, Manbazar-I, Para, Puncha, Raghunathpur-I
Medium(600-899 ham)	Puruliya-I and II
High(900 ham and above)	Jhalda-I, Jaypur, Kashipur.

Source- *Roy, 2014*

Over utilization of surface and ground water for agriculture is another cause of water scarcity.Agriculture occupies vital place in the Purulia district as around 55% of total reported area is net sown area in the district consisting of 3,48,500 Ha. Cultivation of this district is predominantly monocropped. About 60 % of the total cultivated land is upland. Out of the total agricultural holding about 73 % belongs to small and marginal farmers having scattered and fragmented smallholding. Paddy is the primary crop of the district. 50% of the total land is under net-cropped area and only 17% of the net cropped area is under multi crop cultivation. 77% of the net- cropped area is under Aman paddy cultivation. The crops are grown mostly under rainfed condition with low fertilizer input. Productivity is much lower than other district of West Bengal. So maximum amount of water is used for agriculture.

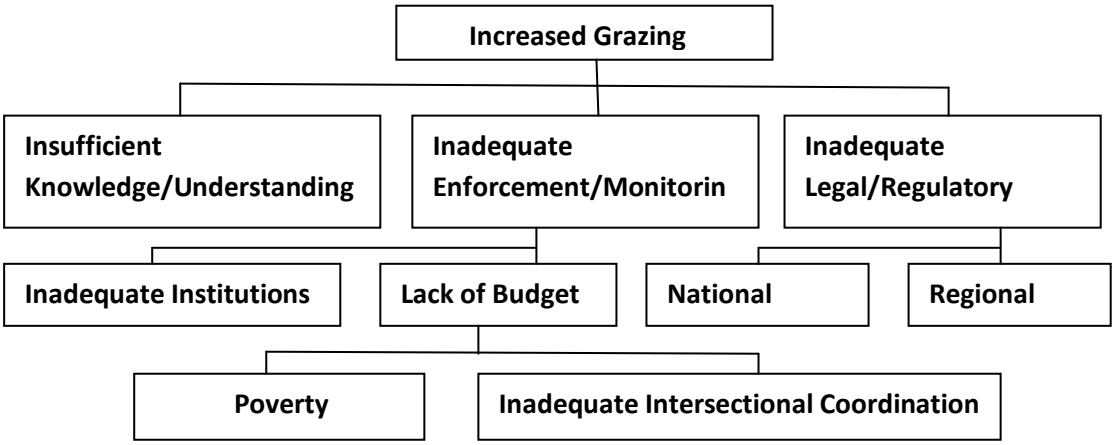
Table-3: No. of Backward villages in different block of Purulia

Serial No.	Name of the Block	No. of Backward villages
1	Arsha	69
2	Bagmundi	98
3	Balarampur	56
4	Bandwan	78
5	Barabazar	80
6	Hura	18
7	Joypur	61
8	Jhalda-I	53
9	Jhalda-II	102
10	Kashipur	25
11	Manbazar-I	75
12	Manbazar-II	39
13	Neturia	38
14	Para	36
15	Puncha	21
16	Purulia-I	44
17	Purulia-II	24
18	Raghunathpur-I	23
19	Raghunathpur-II	30
20	Santuri	24
Total	994	

Source-*Census of India,2001*

Deforestation is one of the prominent activity as population increase day by day. So for fulfilling rising demand for food and shelter the people of Purulia force to destruct the forest for expanding the agricultural land and settlement. Besides some people destructs the natural vegetation in a regular basis for their livelihood. Deforestation causes the high evaporation accompanied with soil erosion which ultimately leads to water loss. Grazing is another important factor of water scarcity as it reduces the infiltration rate of soil.

WATER SCARCITY(*Causal Chain Analysis*)



The district is dominated by illiterate and low income group people which creates ignorance about the water resource. As a result they can not understand the sustainable use of water resource in true sense which results unscientific use of water.

Finally from the above discussion it is cleared that no one single factor is not responsible for the water scarcity of Purulia. It is result of combined effects of different factors like geologically controlled aquifer system, high surface runoff, less precipitation, high temperature, high evapotranspiration, high degree of slope, faulty withdrawls method, over use in agriculture, people ignorance , population growth, deforestation etc.

E) Conclusion:

Water is the most abundant substance on earth, the principal constituent of all living things, and a major force constantly shaping the surface of the earth. It is also a key factor in air-conditioning the earth for human existence and in influencing the progress of civilization(Chow,1988).

Water scarcity affects all social and economic sectors and threatens the sustainability of the natural resources base. Addressing water scarcity calls for an intersectoral and multidisciplinary approach to water resources management, one that ensures the coordinated development and management of water and related resources in order to maximize economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. Integration across sectors is needed. This integration needs to take into account development, supply, use and demand, and to place the emphasis on people and the ecosystems that sustain them. On the demand side, enhancing the productivity of water use in all sectors is paramount to successful programmes of water scarcity alleviation. Furthermore, protecting and restoring the ecosystems that naturally capture, filter, store and release water, such as rivers, wetlands, forests and soils, is crucial to increasing the availability of water of good quality.In conditions of water scarcity, putting in place effective and equitable management practices requires knowledge, expertise and investment at political, institutional and technical levels(UN-WATER,2006).

Numerous innovative technologies exist that have the potential to improve significantly the efficiency of ground water cleanups, especially when technologies suited to specific types of contaminants or specific hydrogeologic environments are combined(Alternatives for ground water cleanup,D.C,1994).

While the pivotal water issues lying ahead bear a strong resemblance to those we have been facing in recent decades, some differences promise to emerge. It is useful to keep these in mind as we develop our thinking on foreseeable responses and the types of economic analysis that will be useful(Griffin,R,2006).

To make a difference on the water challenges we all face, governments, civil society and businesses must work together as never before. For business leaders in particular, we need to speak up, stand up and scale up our efforts on water sustainability(Kent,2011).

The complexity of water management encompasses the varied uses and reuses of water, including human, productive, agricultural and environmental factors.Climate change and more extreme hydro-meteorolog-

ical events will have consequences for dry lands and they will result in changes to agricultural demand and to productive processes. Water-saving systems and the higher efficiency of drop-by-drop irrigation in food production require adequate technologies such as mulching, micro-irrigation tunnels, bio-fertilizers, reuse of agricultural by-products, sensors to measure soil humidity, and the development of efficient irrigation plans according to specific crop needs. Nevertheless, the existing waste of water in agriculture, the lack of trust in government activities, the corruption and the attitudes of traditional producers limit the use and promotion of such technologies, thus impacting adversely on the quality of life of producers, and accounting for both technological and social gaps.

To address these challenges, wastewater collection system managers must be exceptionally proficient in a multitude of technical and non-technical skills needed to efficiently and effectively operate and maintain a collection system. Finally by considering the above all facts related to importance of water, impacts of scarcity of water and sustainable water use it is essential to work hand to hand of people of all section of Purulia, governmental organisation, non-governmental organisation in a holistic manner to secure the water for future generation and to protect the natural ecosystem of world.

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