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## Climate Status of Tripura: A Tight-Rope Walking

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### ABSTRACT

The climate change impacts variously and viciously our earth-rising average sea level around the world, rising global temperature relative to pre-industrial age, melting polar ice, rising of CO<sub>2</sub> level, lowering the ocean pH, changing ecosystems, reduced food security, reduced fertility of land, torrential downpours and more powerful storms, droughts and prolonged heat waves etc. Our little state of Tripura lying in the North-East part of India is also no exception from this global phenomenon. The aim of the present study is to find out the status of Tripura with special reference to temperature change, the trend of average rainfall, the trend of Land use and Land cover pattern, the trend of the ground water level of a particular area, the trend of water quality of the river Howrah. The resulting analysis of different parameters shows that the temperatures, contamination of water are increasing day by day in Tripura. On the other hand, the ground water level is in decreasing order. Such way of decreasing trend will ultimately lead to a hard forthcoming situation. The main causes of misbalance of different parameters are deforestation, urbanization, indiscriminate use of hydrocarbons, etc. This paper strongly urges each student to plant at least one plant for passing their board and university examination under the guidance of a teacher. It also invites every citizen to plant a more number of trees at river source as well as in a river bank, to stop filling of the pond, to produce more numbers of lakes, and to use bicycles instead of motorbikes.

**Keywords:** Climate Change, Temperature, Rainfall, Ground-Water Level, Tripura.

### 1. INTRODUCTION

The climate change refers to significant long-term changes in temperature, rainfall, the quality as well as the quantity of water, air quality, forests intensity, deserts, oceans, snowfall, river, etc. The climate change of a place, say Tripura, can be described as its change in rainfall, temperature, groundwater level, water quality, air quality etc. during the year and so on. The major impact of climate change is food security, global warming, the intensity of droughts and floods, ocean warming and lowering of pH [1]. The rainfall plays an important role in agriculture, plantation, drinking water, fish cultivation, etc. Since there is no big river in Tripura for our agriculture, plantation, drinking water etc. we mainly depend on rainwater. A part of rain water is evaporated directly and the rest reaches the soil by stem flow. Rainfall affects the superficial as well as a deeper layer of soil water, which has a direct link plant and ground water level. The rainfall change modifies the plantation and vegetation pattern of places. Ninety-seven percent of the world's water is found in oceans. Only 2.5% of the world's water are non-saline freshwater [2]. In our state, there is a good relationship between average rainfall and ground water level, the amount of water in the river, ponds, and lakes. The major source of water used to meet our domestic and agricultural needs in Tripura are ground water, river water, ponds, and lakes. The ground water is defined as water that is originating underground in cracks and spaces in soil, sand, and rocks. In recent years, the growth of population, urbanization, agricultural growth, the use of water, which has increased stress upon both ground and river water. The earth's average temperature has risen by 1.5°F over the past century and is projected to rise another 0.5 to 8.6°F over the next hundred years. Small changes in the average temperature of the planet can translate to large and potentially dangerous shifts in climate and weather. India in the last 100 years shows an increasing trend in surface temperature by 0.3°C, a change in the spatial pattern of rainfall with respect to normal and occurrences of more intense and frequent extreme

temperature, rainfall and cyclone events [3]. Among the global challenges global warming having the direct impacts on livelihoods and raising food security, scarcity of water, health problems, changing ecosystems, the disappearance of hundreds of plant and animal species, etc. The Food and Agriculture Organization of the United Nations (FAO) organized several expert consultations on the impacts of climate change on diverse issues related to food security, including the impacts on animal and plant health, implications for emergencies, etc. In view of climate change, some crops may become inappropriate to a region but reorganizing food production systems accordingly may prove difficult because of public preferences. Variation in seasonal performance of crop plants could increase as existing weather patterns break down and new ones form raised the prospect of serious intermittent threats to food security [1]. Due to decreasing the rainfall the water sources gradually getting dry and lowering the ground water level, which results in the change in habit of plants and vegetable of that region. Studied of weather events in India have shown that during the period 1870–1990, there were 11 drought years, which were associated with warm El Niño Southern Oscillation (ENSO) events, while there were 10 droughts which were not associated with warm ENSO events [4]. Droughts directly damage crops and degrade the land and desiccate the underground reservoir. Droughts are a serious threat to the food security. Like other factors, there is a relationship between global warming and health problems. Malaria is one of the examples which is an extremely climate-sensitive tropical disease [5]. The optimal temperature range for development of malaria vector lies within 20°C to 30°C. However, for transmission of *P. vax* requires a minimum average temperature of 15°C and transmission by *P. falciparum*, requires a minimum temperature of 19°C [6]. How malaria incidence related to temperature, humidity is shown in Figure 1.

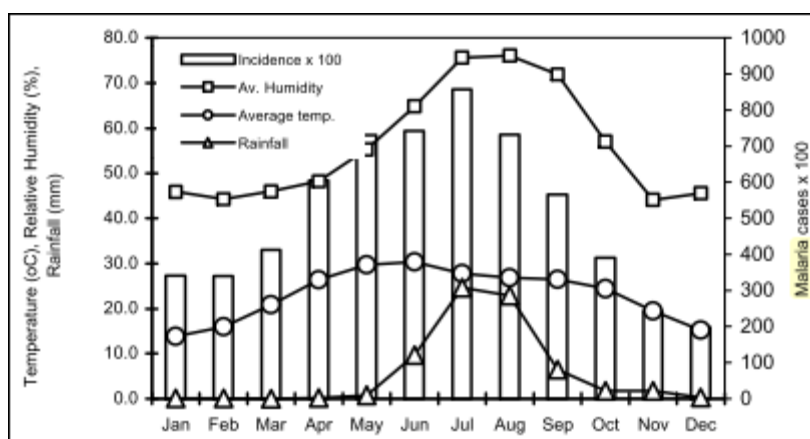


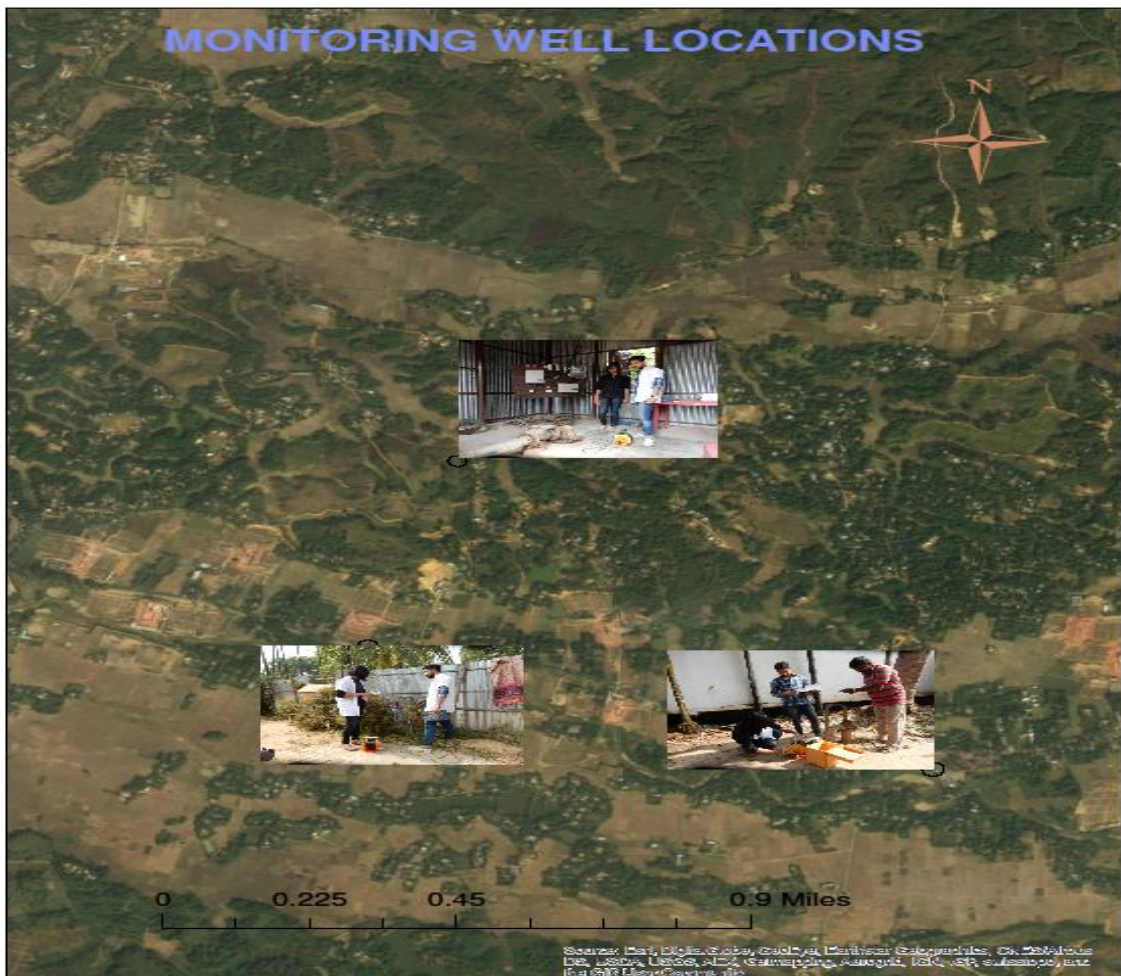
Figure1. Trends of average monthly temperature, precipitation, relative humidity and malaria cases in India between the period 1970 and 2000 [6].

Ozone depletion due to uncontrolled use of CFC passing the UV radiation to the earth. Which have the potential influence to increase the incidence of skin cancer through different means [7]. Global climate change presents new region-specific health risks. Studies of climatic influences on infectious diseases have mainly focused on the influence of El Niño/Southern Oscillation (ENSO). ENSO has been found to be related to incidences of malaria in South America, rift valley fever in east Africa, dengue fever in Thailand, hantavirus pulmonary syndrome in the southwestern USA, childhood diarrhoeal disease in Peru and cholera in Bangladesh [8]. Several researcher published their findings on different parameters of climate of Tripura like ‘Pollution Status Assessment of Haora River’ [9], Geo-environmental status of the river Gumti, Tripura, A Short-Term Project Report [10], Ground Water Information Booklet North Tripura District, South Tripura District, Tripura [11], Water: A Review of Tripura by Biswendu Bhattacharjee [12], water quality assessment of river Haora in Agartala stretch during Durga idol immersion [13], arsenic contamination in groundwater of North Eastern India [14]. The data on climate change for each state of the country during the last 60 years (1951–2010) in respect of temperature, rainfall for each state published in ‘State Level Climate Change Trends in India’ [15]. In the present paper, we have attempted to bring the systematic analysis of these with respect to Tripura and included the study report of the ground water level of a particular area of west Tripura District and how water parameters changes with ground water level, study the water parameters the river Howrah from 2010-2017. On the basis of the study report, we made some suggestion to overcome these problems.

## 2. MATERIALS AND METHODS

The temperature record and rainfall record were collected from literature [15]. We have determined the water quality data of the river Howrah from 2014-2017 at our laboratory and ground water level of 2017. The ground water and its water quality data was collected from Champak Nagar bazaar and its geographical location N-

23°48'269", E-091°29'198", Help hang Dugwell geographical location N-24°50'445", E-091°22'878" Krishnanagar (GP) geographical location N-23°50'443", E-091°22'874" and Madhya Debendra Nagar geographical location N-24°51'400", E-090°20'871" under Jirania Subdivision, West Tripura District area. The data of water level and iron content from 2007–2016 were collected by TPCB, Govt. of Tripura. The measurement of water level was done by the well, which was built by TPCB and water level was measured by using 'Water Level Electro Prove Sensor'. We have collected the water level data and iron content of the well for the year 2017 only. This study evaluates long-term cumulative depletion volumes in 4 separate aquifers or areas, bringing together information from the literature and from new analysis. The hardness (in ppm), turbidity (in NTU), pH and iron content of river Howrah and iron content of four well of Jirania area were measured using a standard protocol. The data on water quality of the river Howrah by our laboratory in every year since 2014. Rathore et al already published the data on temperature record and rainfall record [15]. Here we present the trends of these records graphically and the relation of rainfall and temperature with the water level as well as water quality. Other than this here we correlate the incidence of malaria with a temperature of Tripura. The graphical analysis was done by SPSS software which is available in our college.

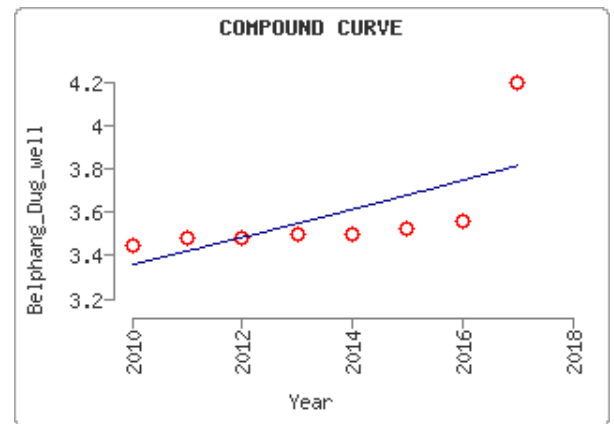
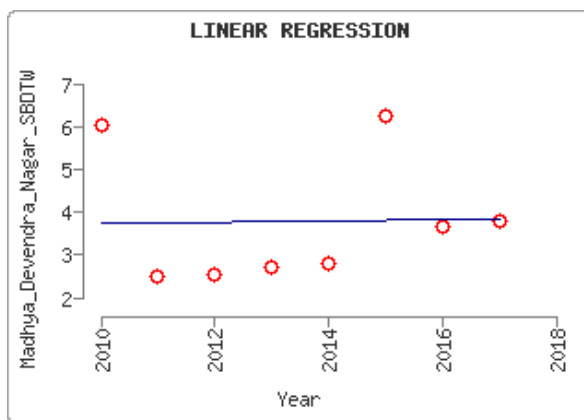
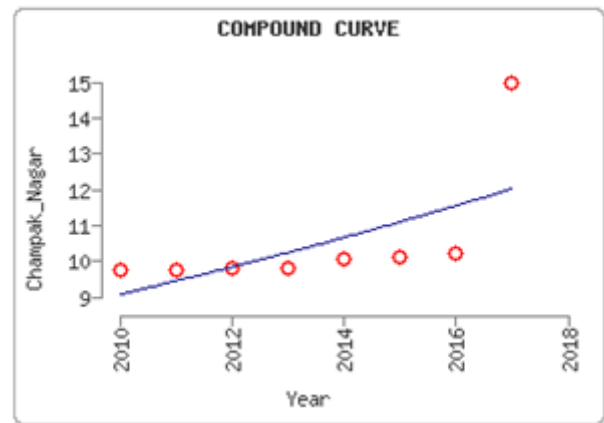
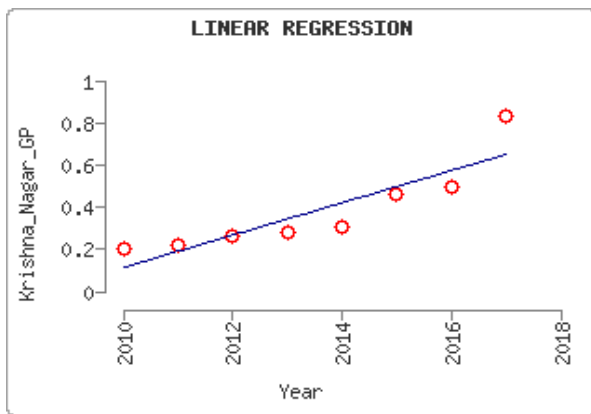


### 3. ANALYSIS AND INTERPRETATION

The survey report of ground water level from 2007 to 2017 of Champak Nagar, Help hang Dugwell, Krishnanagar, and Madhya Debendranagar of Jirania subdivision under West Tripura district are shown in Table 1 and water level trend is shown in Figure 2.

Table 1 Survey of ground water level 2007-17 (in meters)

locations	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Champak Nagar bazar	9.65	9.65	9.72	9.75	9.75	9.78	9.80	10.05	10.10	10.23	15
Belphang Dugwell	3.45	3.45	3.45	3.45	3.48	3.48	3.50	3.50	3.52	3.56	4.2
Krishnanagar(GP)	0.10	0.15	0.18	0.20	0.22	0.26	0.28	0.31	0.46	0.50	0.83
Madhya Debendra nagar	2.25	2.31	2.38	2.45	2.51	2.56	2.69	2.78	3.11	3.67	3.8



From the figure it is clear that the water level of all the well is reducing except Madhya Debendranagar which is steady. The iron content of the above locations measured experimentally and are represented in Table 2 and the trends of iron content are shown in Figure 3.

**Table-2: Iron content**

Name of place	2012-13	2013-14	2014-15	2015-16	2016-17
Champak Nagar	1.40	1.52	1.70	1.78	1.80
Belphang	0.89	1.08	1.11	2.28	2.44
Krishnanagar	0.78	1.05	1.60	1.79	0.50
Madhyadebandranagar	0.89	1.05	1.11	2.28	2.5

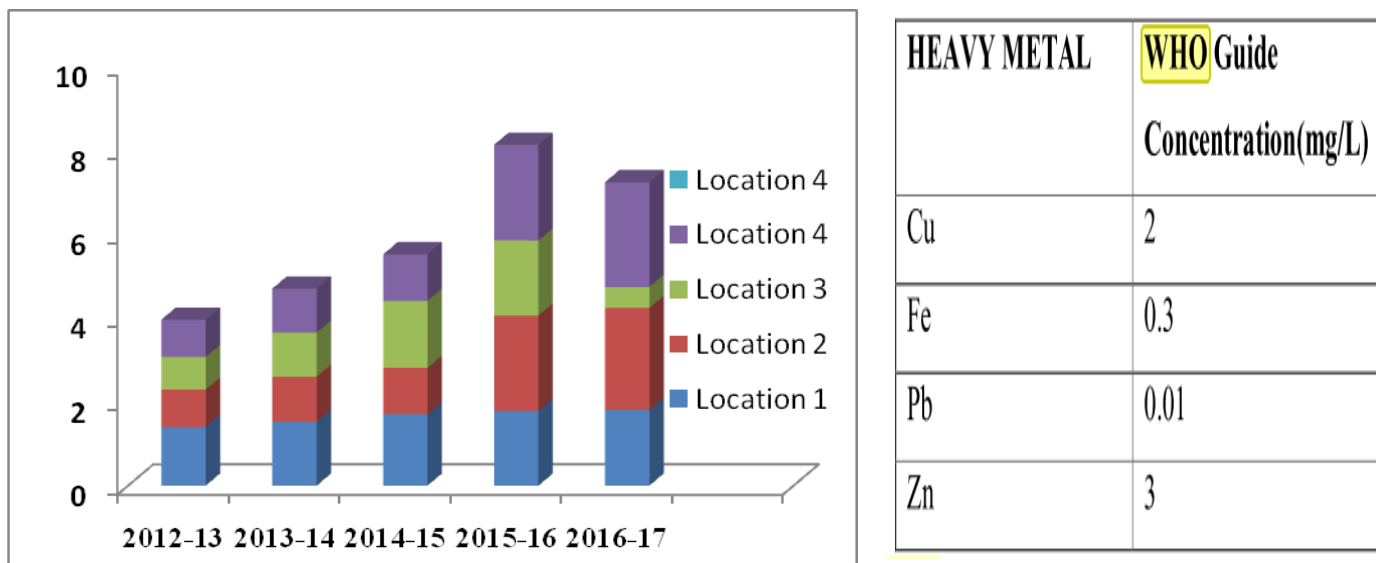


Figure 3. The iron content of different location from 2012–2013 in ppm (Location 1: Champak Nagar, Location 2: Help hang, Location 3: Krishnanagar, Location 4: Madhyadebendranagar)

The quality of ground water is not very bad at present; there may be problems if the ground water level is decreasing as in present order in future. Because the iron content increasing every year. There is a relationship between ground water level and quality of water. The metal ions have increased and become unfit for drinking and another purpose in future. Hence, this is high time to preserve and protect this precious resource. The main causes of degradation of different parameters are deforestation, urbanization, indiscriminate use of hydrocarbons, etc.

There are lots of controversy regarding global warming. Inter-Governmental Panel for Climate Change (IPCC) president stated that ice of Himalaya will be finished by 2035 and 1/5<sup>th</sup> of Bangladesh will be immersed by 2050 due to global warming. On the other hand A. K. Dubey, Director Wadia Institute of Himalayan Geology in his statement in Hindustahn Times that the ice of Himalaya is unaffected and there is no abnormality shown till date and satellite picture of last 30 years showed that 1000 so. area of costal area increases in Bangladesh [17]. There are some other factors like heat cycle, the source of heat of the earth, rotation of the earth, milankovitch cycle etc. are related with global warming. The temperature data of Tripura (1995-2007) presented in Table 3 and is represented in Figure 4, do not show any significant trend. In some year maximum temperature increases and in some year temperature decreases

**Table 3: Average Max. Temperature in °C 1995-2007**

YEAR	Max	Min
1995	34.00	15.1
1996	34.20	14.9
1997	33.00	15.0
1998	33.40	16.7
1999	34.10	17.0
2000	33.25	17.0
2001	33.50	17.6
2002	33.60	17.6
2003	33.45	16.4
2004	33.10	16.2
2005	33.58	17.7
2006	34.45	18.0
2007	33.35	06.2

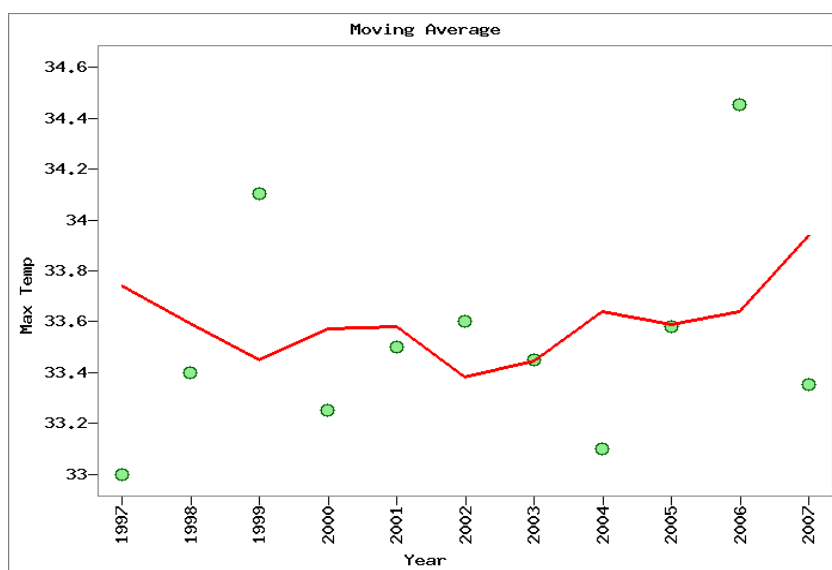
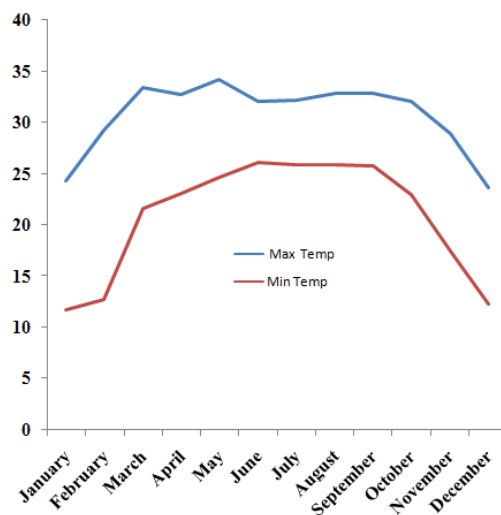
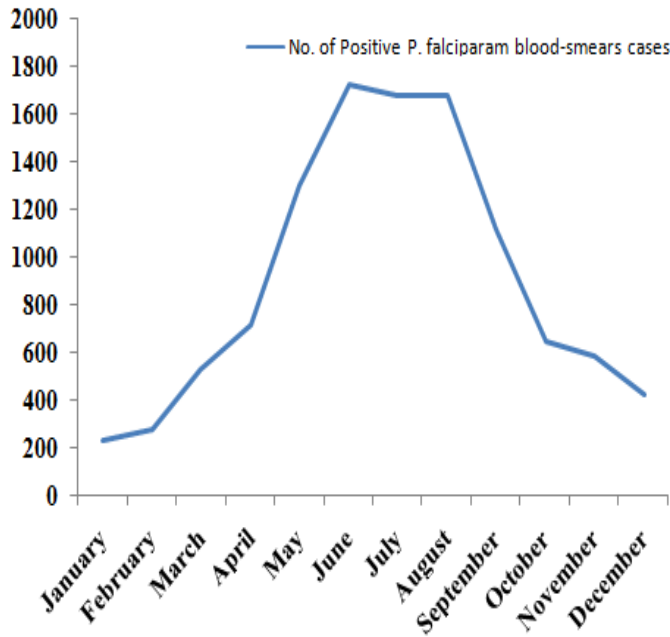


Figure 4: Change in temperature of Tripura from 1997-2007 Although the temperature from 2003 to 2007 rising.

**Table 4:** Month wise minimum & maximum Temperature 2012 & No.of Positive *P. falciparum* blood semars

Year 2012	Max Temp (°C)	Min Temp (°C)	No. positive <i>P. falcipara</i> blood
January	24.3	11.7	231
February	29.2	12.7	280
March	33.4	21.6	532
April	32.7	23.1	713
May	34.2	24.6	1299
June	32.1	26.1	1724
July	32.2	25.9	1680
August	32.8	25.9	1681
September	32.8	25.8	1117
October	32.1	23.0	649
November	28.9	17.4	587
December	23.6	12.3	422

Data Source: Dev et al. *Indian J Med Res*, 142, 2015, pp 12-22



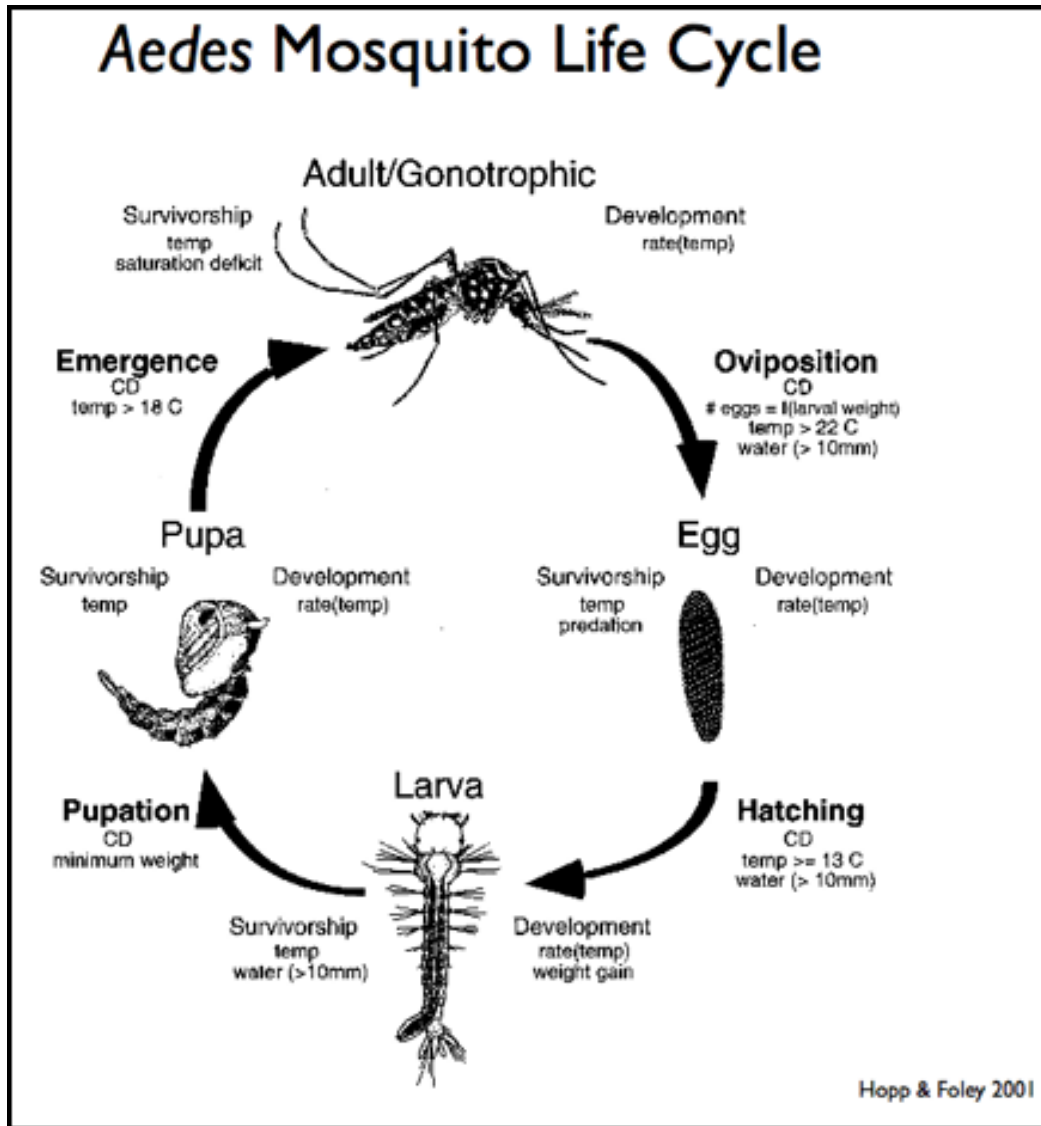
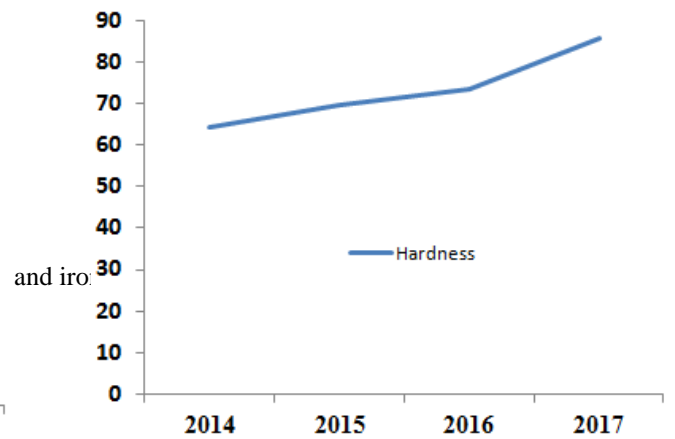
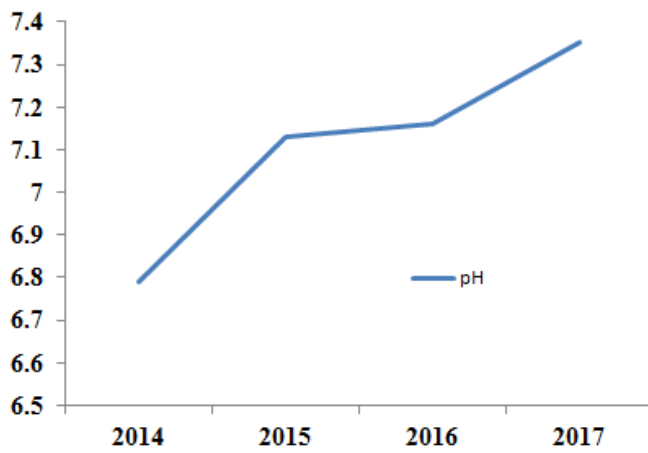
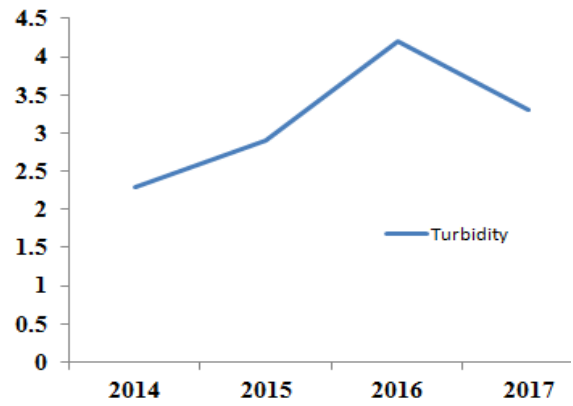
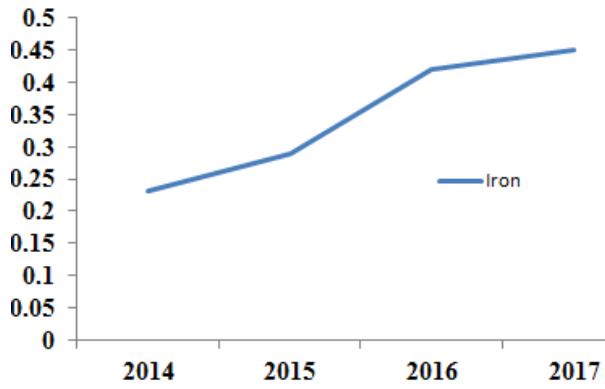


Figure 5. Temperature and monthly distribution of a number of positive *P.falciparum* blood-smears cases in the year 2012 in Tripura.

Dev et al in their study reviewed the data on malaria distribution to prioritize high-risk districts, and to study the seasonal prevalence of disease vectors and their biological characteristics to help formulate vector species-specific interventions for control of malaria [16]. Since malaria is one of the climate sensitive diseases we try to correlate the incidence of *P. falciparum* attack with temperature. From the Figure 5, it is clearly showed that there is a good co-relation between malarial incidence with temperature and *P. falciparum* attack. The nature of both curves is very similar which indicates with increasing minimum and maximum temperature malaria attacked increases.

Year	2014	2015	2016	2017
pH	6.79	7.13	7.16	7.35
Hardness ppm)	64.35	69.59	73.60	85.61
Turbidity	2.30	2.90	4.20	3.30
Iron (mg/L)	0.23	0.29	0.420	0.45



The pH, turbidity, hardness and iron content of river water of Howrah are in increasing order. The water parameters of river Howrah are presented in Table 5 and their trends are shown in Figure 6.





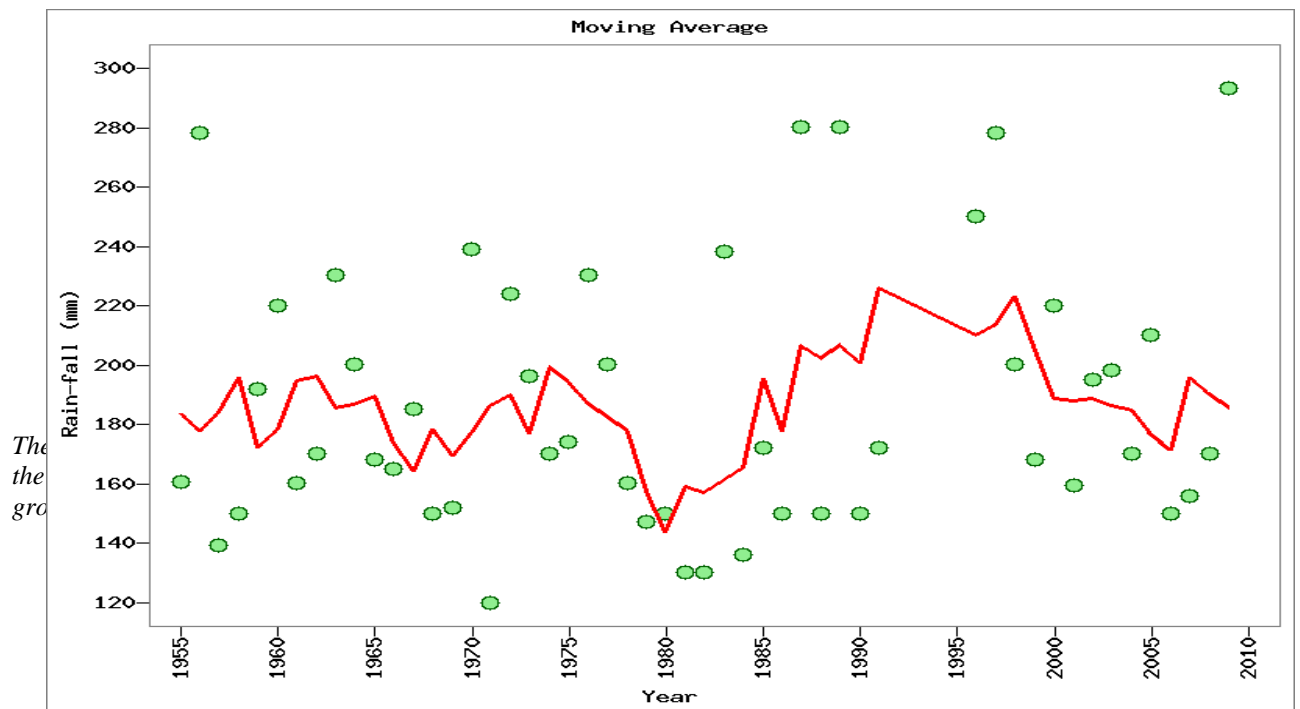
Structures and formation of Howrah Basin Area



The state is a high rainfall zone with the incidence of very high concentration of rainfall up to 450 mm per day in the monsoon season which lasts from June to September. The Average annual rainfall in the state is 182.63 mm from 1953-2011. Max rainfall is generally received in the month from July to September. Intermittent rainfall is received round the year but the pattern of rainfall is not homogenous presented in Figure 7. Thus the trend shows that there is not much variation in the average rainfall from the year 1953 to 2011. But the problem is mainly due to variation in its intensity.

YEAR	RAINFALL	YEAR	RAINFALL	YEAR	RAINFALL
1953	180	1971	120	1989	280

1954	160	1972	224	1990	150
1955	160.7	1973	196	1991	172
1956	278	1974	170	1996	250
1957	139	1975	174	1997	278
1958	150	1976	230	1998	200
1959	192	1977	200	1999	168
1960	220	1978	160	2000	220
1961	160	1979	147	2001	159.2
1962	170	1980	150	2002	195
1963	230	1981	130	2003	198
1964	200	1982	130	2004	170
1965	168	1983	238	2005	210
1966	165	1984	136	2006	150
1967	185	1985	172	2007	156
1968	150	1986	150	2008	170
1969	152	1987	280	2009	293
1970	239	1988	150	2010	180
				2011	128



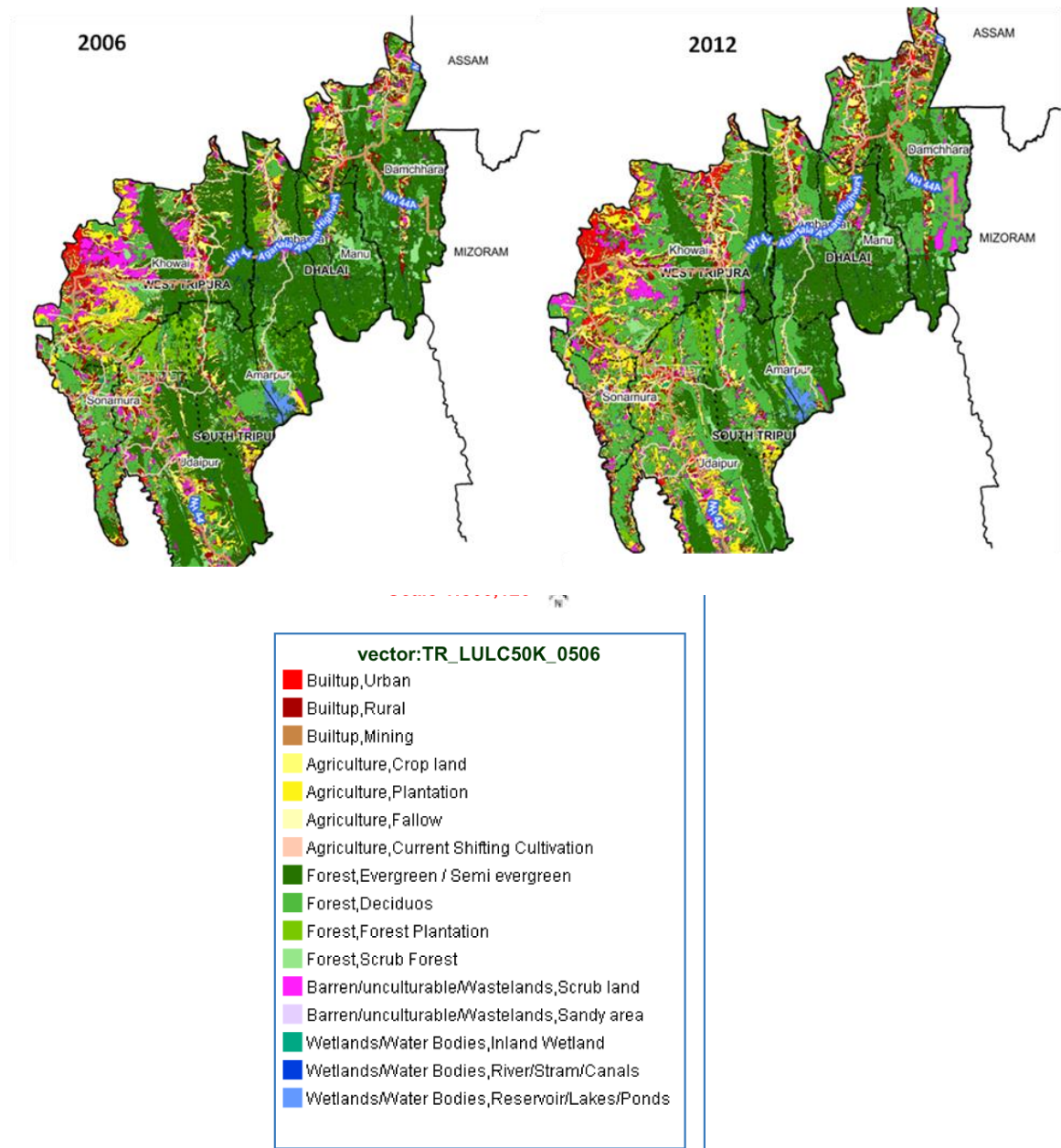


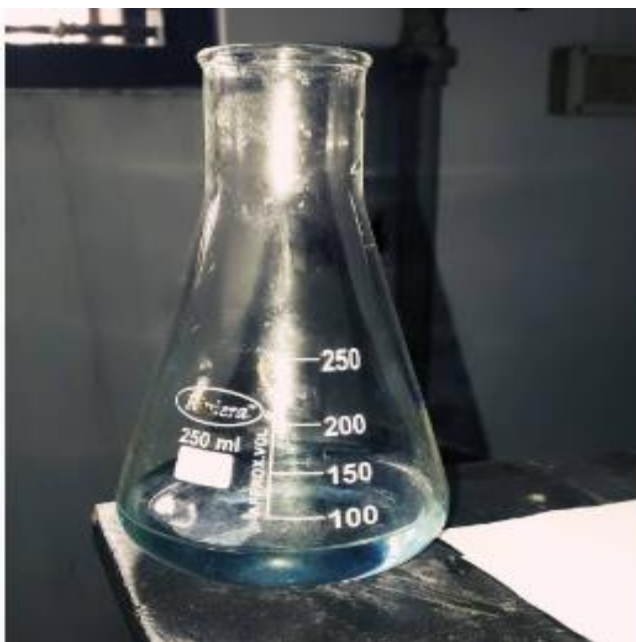
Figure 8. Land use land cover picture of Tripura in the year 2006 and 2012



Figure 9. Irregular river bed [source: De Sunil Kumar, Geo-environmental status of the river Gumti, A short-term project report]

#### 4. CONCLUSION

This study showed that the ground water level of four wells are decreasing and simultaneously the iron content of those wells water increasing. There is no remarkable change in temperature of Tripura but in a particular year with changing temperature, the malaria incidence increases remarkably. The rainfall pattern depicted above does not show any remarkable changes but it is non-homogenous throughout the year. The river water quality of Howrah degrading day by day. The main cause of reduction of the ground water level is deforestation in the source of the river which is clearly indicated by the satellite picture. Due to deforestation the rate of rainwater evaporation increases, soil erosion increases which reduce the depth of river also. These drastic changes due to change in climate have already resulted in so lot of disruptive effects. So it's nearly probable that if such trend continues, the word CLIMATE CHANGE will nothing less than a disaster. As an easy and simple solution to this problem, we can come up with the step of including planting trees as a part of our academy and Students under the guidance of their respective teachers must go for planting at least one tree, on which students will be given marks as a part of their examinations. In such way, stakeholders must seek for many such initiations and come up with solutions to the biggest problem of today's world.



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