

CHAPTER-II

GEOGRAPHICAL BACKGROUND OF THE STUDY AREA

2.1. Introduction:

Study Area is the prime concern of any research especially in a spatial science like Geography. It is the place, based on which, the researcher carries out in-depth study and data collection. A discussion on the study area is fundamental as it helps in understanding the contextual background of the area under investigation. Mead defined study area as “the geographical studies pursued in a well-defined area” (Mead, 1969). Generally, a research is conducted within or beyond an area delimited by political or physical boundaries. However, it is sometimes difficult to delineate a study area as it may stretch beyond either of the boundaries. The study area is the geographic framework within which the field work is conducted, and thus its exact areal extent must be determined to focus and further define the purposes of the research. As the present research is based on the Geo-environmental study of the wetlands of Tufanganj and Koch Bihar Sadar subdivisions within Koch Bihar District, the study area and subsequent data collection have been confined to four community development blocks, namely Tufanganj-I, Tufanganj-II, Koch Bihar-I and Koch Bihar-II. Thus the main focus of the present chapter is on the historical background, physical and socio-economic background as well as the administrative jurisdiction and geographic location of Koch Bihar District.

2.2. Historical Background:

Etymologically, ‘Koch Bihar’ or ‘Cooch Behar’ has been derived from two words- ‘Cooch’ and ‘Behar’. While the word ‘Cooch’ is a corrupted form of the word ‘Koch’ that signifies an indigenous mongoloid tribe, the word ‘Behar’ is derived from Sanskrit word ‘Vihara’, which means ‘abode’, or ‘sport’. Thus HN Chowdhury (1930) rightly described Koch Bihar as the ‘land of sporting with the Koches’. On 13th April 1896, Maharaja Nripendra Narayan in a notice published in the Cooch Behar Gazette approved the name ‘Cooch Behar’, however later the term ‘Koch Bihar’ was used in 1981 of the census of India.

The territory of Koch Bihar has its mention in the Epics and Puranas as the part of Pragjyotichpur or Pragjyotisha which extended from Bay of Bengal in the South and Koshi

River in the west. The region was inhabited by indigenous people who were attributed the names Danaba, Asura, Kirat etc. In the 2nd half of the century, the area was known as 'Kamrupa' (Debnath, 2008). The Kamrupa was mentioned in the Allahabad Inscription of Samudra Gupta. Between 7th and 12th century the land was ruled by different dynasties like Guptas and Palas. In the later stage the Kamrupa Kingdom was ruled by Khen dynasty and named as 'Kamta' and Khen king Nildhwaja established his capital at Kamtapur near Koch Bihar and it was extended to parts of Dinajpur, Jalpaiguri, and Rangpur of Bangladesh. In 'Baharisthan -i- Ghaibi' the area was named as 'Kamta'. J. Blaeu (C.1664) in his world Atlas 'Nova et Accuratissima Terrarum Orbis Tabula' mentioned the land as '*Comotay*'. Koch Bihar was first used in 'Shah Jahan Nama' in the middle 17th century. After the fall of Pala dynasty (C.900-C.1100), the Khen dynasty was established in 1185AD by Prithu. However, in 1498 AD the khen lineage to the throne came to an end when Alaudding Husain Shah, the independent sultan of Gour defeated the last khen ruler Nilambar. Again in 1505 the kingdom passed into the hands of the Ahom king Sahungmung. However, taking advantage of the political upheaval the indigenous Koch tribe assumed full control and the Koch dynasty was established in 1515AD by Koch Raja Viswa Singha. In 1581, the Kamtapur kingdom was again divided into two parts – Koch Bihar and Koch Hajo- demarcated by Sankosh River. The Koches were the collection of Mongoloid race who was the admixture of Mech and Koch Hajo tribes. In course of time Koch Bihar transformed from a Kingdom to a princely state under the protection of the British Government from 1773 and notably in 1863, Colonel J.C.Haughton was appointed to cater the minor Maharaja Nripendra Narayan (one year old). After Independence of India in 1947, Jagaddipendra Narayan the last ruler of Koch Bihar transferred full power and jurisdiction to the Government of India on 12th September, 1949. On the basis of the Government of India Act, 1935 and under the order of U/S 290A, the Koch Bihar merged with the state of West Bengal on 1st January, 1950 under Jalpaiguri division.

2.3. Administrative Background:

2.3.1. Administrative Boundary of Koch Bihar:

The district of Koch Bihar is a part of the Himalayan Terai of West Bengal. Koch Bihar district is bounded by rivers and International, State and district boundaries. Raidak in Tufanganj subdivision and Jaldhaka in Mekhliganj subdivision form the boundaries. While the western

part of the district is bounded by Jalpaiguri Sadar, Maynaguri and Dhupguri blocks of Jalpaiguri district; northern part is bounded by Alipurduar and Kumargramduar of Alipurduar district. In the East, Koch Bihar is bounded by Goalpara district of Assam and in the Southern part, it is bounded by Boda, Debiganj, Domar, Dimla, Patgram, Hatibandha, Kaliganj, Lalamonirhat, Phulbari, Nageswari and Bhrungamari of Bangladesh. The total geographical area of the district is 3387 sq.km after the inclusion of Panishalamouza of Maynaguri PS of Jalpaiguri district in 1981. Approximately Koch Bihar extends from 25°57'57" N to 26°32'58" N latitude and 88°45'28"E. to 89° 51'50" E longitude.

Table 2.1: Administrative Setup of the Study Area

Sub-Divisions	P.S.	C.D Block	Towns		No of Inhabited Villages	Total No of inhabited villages	
			Municipal	Census Town			
Dinhata	1.Sitai	1.Sitai	-	-	53	299	
	2.Dinhata	2.Dinahata-I	1.Dinahata	1.Bhangri PrathamKhanda	130		
		3.Dinahata-II	-	-	119		
Tufanganj	1.Tufanganj	1.Tufanganj-I	1.Tufanganj	1.Kamat Phubari	72	126	
	2 .Baxirhat	2.Tufanganj-II	-	2.Chhota Laukuthi	54		
Mathabhanga	1.Mathabhanga	1.Mathabhanga-I	1.Mathabhanga	-	102	260	
	2. Ghokshadanga	2.Mathabhanga-II	-	-	92		
	3. Sitalkuchi	3.Sitalkuchi	-	-	67		
Mekhliganj	1.Mekhliganj	1.Mekhliganj	1.Mekhliganj	1.Nagar Changrabhanda	140	198	
	2.Kchlibari	2.Haldibari	2.Haldibari		58		
	3.Haldibari						
Koch Bihar(Sadar)	1.Koch Bihar Kotwali	1.Koch Bihar-I	1.Koch Bihar	1.Kharimala Khagrabari	142	143	
				2.Guriahati			
				3.Dhaliabari			
		2.Koch Bihar-II			1.Baisguri	111	116
					2.Chakchaka		
3.Takagach							
4. Baneswar							
5. Khagrabari							
5	11	12	6	12	1140	1140	

Source: DCHB, 2011 and Census, 2011

2.3.2. Administrative Set up of Koch Bihar:

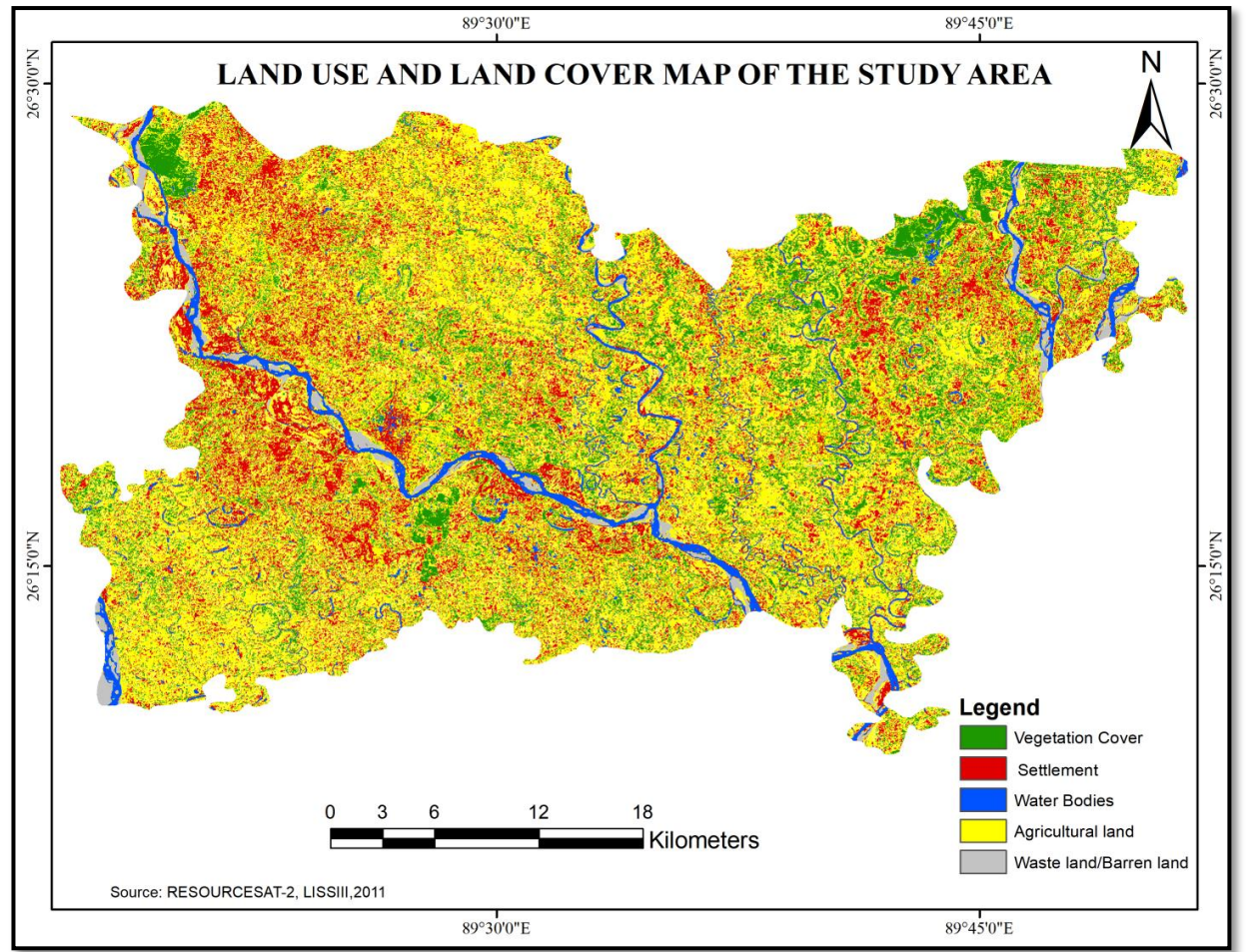
At the time of merging into the Dominion of Government of India, Koch Bihar District had 5 subdivisions (Vide Notification No- 3549,GA on 1st January,1950) namely Koch Bihar Sadar, Dinhata, Tufanganj, Mathabhanga and Mekhliganj and 8 police stations namely Kotwali, Dinhata, Sitai, Tufanganj, Mathabhanga, Sitalkuchi, Mekhliganj and Haldibari. Later 3 more police stations were added to the district namely Ghosadanga, Kuchlibari and Baxirhat. The district has been divided into 12 community development blocks and 1202 mouzas out of which 1140 mouzas are inhabited. The district has 6 municipalities namely Koch Bihar, Dinhata, Tufanganj, Mathabhanga, Mekhliganj, Haldibari which comprises of 80 municipal wards and 12 census towns.

2.3.3. Location of the Study Area:

The study area lies between Sankosh- Mansai interfluves. The area is bounded by Mathabhanga-II in the west, Dinhata Subdivision in the south, Assam in the east and Alipurduar district in the north. The whole area comprises two subdivisions namely Tufanganj and Koch Bihar Sadar. Besides, the study area has 4 community development blocks viz. Tufanganj-I& II and Koch Behar-I& II (Map-2.1). The geographical coordinates of the area are 26°9'8"N to 26°29'24"N and meridians of 89° 17' 34" E to 89° 51'50"E. The study area has 380 mouzas with 285750 households as per 2011 records. There are 2 municipalities and 10 census towns in the two subdivisions along with 32 wards. The total geographical area of the study area is 1341.28 sq km (39.60% of the district). Total population according to 2011 census in Tufanganj subdivision and Koch Bihar subdivision is 4, 56,319 and 1, 75,419 (42.73 % of the district) respectively.

2.4. Physical Background:

Physical background of any study area is concerned with natural features and phenomenon of the earth's surface such as geology, Physiography and relief, climate, drainage system, soil and natural vegetation.



Map 2.1: Land use and Land cover Map of the Study Area

2.4.1. Geology:

The region is studied based on morpho and litho-stratigraphy. The northern part of the district along the Siwaliks or foothills of Bhutan Himalayas constitutes of alluvial fan sediments, which lie unconformably. The fan sediments are divided into 3 formations viz. 1) Deema formation 2) Jayanti formation and 3) Santrabari formation. Highly assorted sub-angular large boulders and pebbles of high-grade gneiss, granite and quartzite characterize the Deema formation. This formation also has Carbonized plant remains in the lower altitudinal area. On the other hand, Jayanti formation is characterized by mélangé with an admixture of the matrix and clastic rocks which are smaller in size than those in Deema Formation. Constituents also range from Khaki and reddish brown silt to fine-grained sand which is susceptible to gully erosion. This formation also shows weak stratification at some places. Santrabari formation is generally found at the highest topographic level, its constituents range from small boulders to pebbles, with compact

stratification. This formation is also characterized by small quantities of carbonized plant remnants.

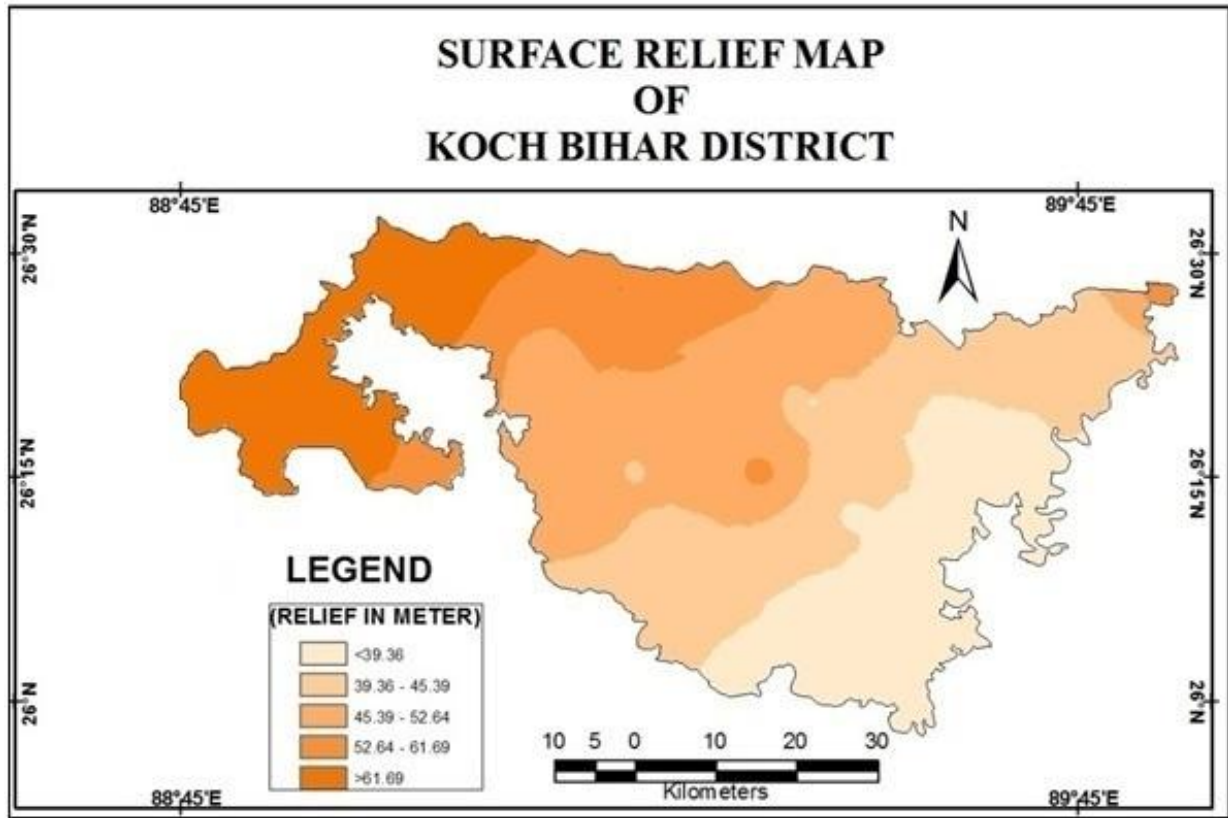
The southern part constitutes of alluvial flood plain elements. The flood plain is divided into 3 formations, namely 1) Present day Flood Plain formation 2) Shaogaon formation and 3) Baikanthapur formation. Present day flood plain deposits comprise of fine greyish silver micaceous sand which is deposited as point bar, mid-channel bars along the river bed. The Shaogaon formation lies above the present day flood plain deposits. This formation is slightly undulated and has sparsely distributed human settlements. The formation is inundated by flood during the monsoon period. The Baikanthapur formation lies in the upper part of the flood plain and is hardly inundated by the flood. This formation is characterized by grey to dark grey alluvium.

Neo-tectonic activities are common in this area along the faults and it affects the fan and flood plain deposits. The area has witnessed several tectonic activities during Quaternary times which have resulted in the frequent alterations of the size of sand and silt and sudden changes in the steam gradient. It is assumed that the Deema, Jayanti and Santrabari formations are Glacio-Fluvial in origin. It is further observed that the Santrabari is the primary Fan and Jayanti is the secondary fan. The provenance of the Deema formation indicates that the materials are carried from a distant location. The older alluvium formation is absent at 304 m bgl. Thus it may be assumed that Siwaliks and other Tertiary deposits, if present, occur below this depth.

2.4.2. Relief:

Physiographically Koch Bihar district lies below the sub-Himalayan region of West Bengal. This zone comprises the plains of Jalpaiguri, Koch Bihar and Siliguri sub-division of Darjeeling district. The region is demarcated as Terai which is formed by the deposition of sand, gravel and pebbles brought in by the rivers. Koch Bihar basically is a flat province with a slight south-eastern slope along which the main rivers of the district flow. A number of rivers and their tributaries have traversed the district. Due to the lower course, the rivers flow in the meandering course and most of them form natural levee and ox bow lakes. The region is, thus, a flood-prone area which is inundated during the monsoon season. Numerous remnant channels which

are present in the region create bills, locally known as *Chhara*. In the district, elevation of Sitalkuchi block is the highest and Sitai is the lowest. The average height of the district is 60 m msl(Map 2.2).



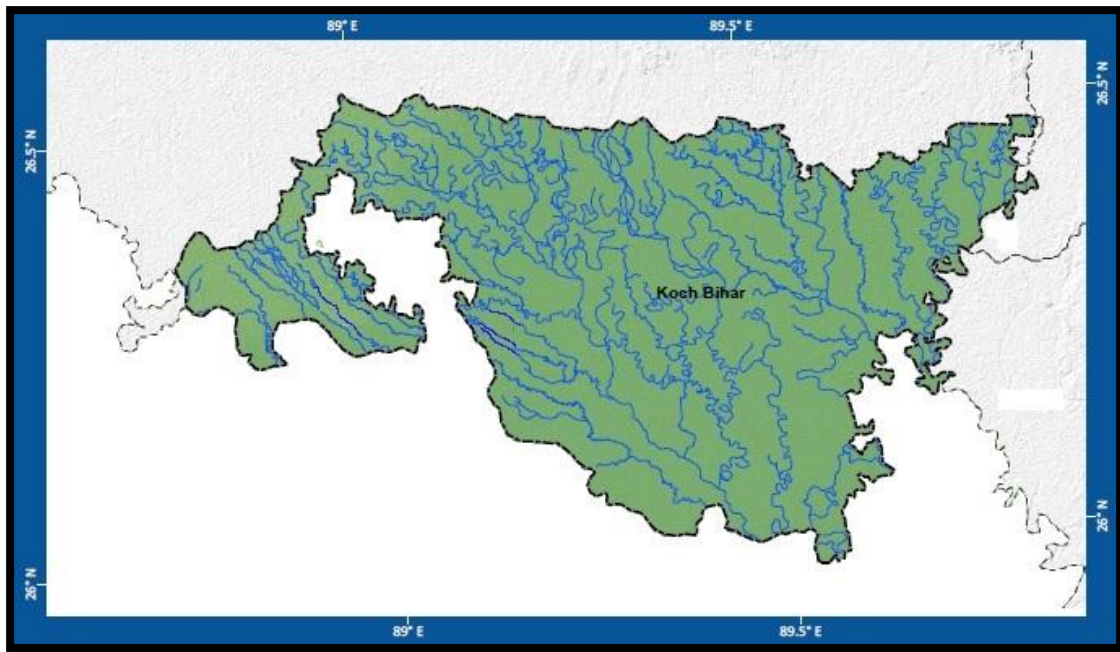
Map 2.2: Surface Relief Map of Koch Bihar, Source: SRTM 3 Arc Second DEM

2.4.3. Drainage:

Koch Bihar district is a well-drained region owing to a number of river systems. The rivers are mostly perennial and ephemeral in nature, and a majority of them originates from the northern Himalayan Mountains and is snow fed. Irrespective of their origins, either from the glaciers of Greater Himalayas or the lesser Himalayas, the rivers of the district finally enter into the Brahmaputra in Bangladesh. During their course in the hills and the Dooars region, the rivers carry heavy loads of sediments, which are deposited, along the foot hills and eventually these sand and silt are carried across the river to be deposited along the riverbeds.

The region has 6 major river systems (Map-2.3) viz. 1) The Tista system 2) The Jaldhaka system 3) The Torsa system 4) The Kaljani system, 5) The Raidak system and 6)

Sankosh or Gangadhar system. A brief account of the important rivers of the district is discussed in the table-2.2.



Map 2.3: Drainage System of Koch Bihar

2.4.4. Climate:

2.4.4.1. Temperature:

The climate of Koch Bihar District is hot-humid and sub-tropical in nature. The cold season is observed from mid-November to the end of February. This is followed by hot season from March to May. During June to August south-west monsoon causes heavy rain fall in the district. During summer, April is the hottest month with a mean daily maximum temperature of 32°C and mean daily minimum temperature of 20°C. Koch Bihar experiences cold winters, characterized by foggy mornings and nights. Starting from the end of November and lasting until February mercury rises to a maximum of about 24°C with minimum temperature about 10°C. The temperature begins to drop steadily from December and reaches to its lowest between the last week of December and second week of January. The transition from cold to hot weather and from hot to cold weather occurs in the months of March and October respectively denoting spring and autumn in Koch Bihar. The weather is very pleasant during this time.

Table 2.2: Major River Systems of the District

SI No	Name of the River	Source	Local Name	Length	Basin area	Mouth	Tributaries	Basic Features
1	Tista	Pahunri Glacier, at 7068 m in Sikkim	Lachen Chu and Lachung Chu	310.15km 24 km in Koch Bihar	12450 km ²	Brahmaputra at Kurigram, Bangladesh	<p>Right:Dik Chu, Rangpo,Lang Lang Chu, Rani Khola</p> <p>Left:Ranghap Chu, Rangit, Ringyong Chu, Rajini, Lish, Ghish, Karola,</p>	<ul style="list-style-type: none"> * It enters in Koch Bihar at Boxiganj, in Mekhliganj. * It runs through Mekhliganj and Haldibari * It is divided into 6 branches * Tista has 3 distributaries- Two BuriTista and another Mora Tista
2	Jaldhaka	Bidang lake at Sikkim	Di Chu and Li Chu	192km 87 km in Koch Bihar	3960 km ²	Dharla river near Kuri gram and finally Brahmaputra	<p>Right: Bindu, Murko, Murti, NaksalKhola, Sutunga, Jarda, Khutamara or Giridhari</p> <p>Left: Diana, Rehti-Duduya, Mujnai, Kumlai, Gelandi, Dolong, JariDharla, BuraDharla,Malda, Baniadaha, Nilkumar</p>	<ul style="list-style-type: none"> * It has several names- the upper part is known as Jaldhaka, Middle part Mansai and then Singimari and after merging with Dharala in Bangladesh it is named as Dharla. * It enters in the district in the North-West corner near Kheti and then flows South Easterly direction
3	Torsa	Chumbi Valley in Tibet, at 7060 m height .	Ma Chu in Tibet and in Bhutan Amo Chu	358 km , 60km in Koch Bihar	4883 km ²	Brahmaputra near Kurigram	Holong, Kala Torsa, Malangi, Raidak -1, Ghargharia, Kaljani, Gadadhar, buraRaidak, Sanfola, Mora Torsa, Sanjai, Khutamura, Rasmoti, NayaTorsa, Bherbheri or Sengsengi	<ul style="list-style-type: none"> * Torsa river has two parts in the duars- ShilTorsa and Char or BuraTorsa * Char Torsa merges to ShilTorsa at Khopatuli * BuraTorsa and Mujnai merged together and was flowing in the south * After merging Torsa and Bura Mansai at Kalpani, The Torsa has been divided into two parts- one is Dharla and another is the Torsa. *Bura Mansai merged to Khutamara River. * Ghargharia, Kaljani, , Raidak-1 all are fall in the Torsa river and named as Dudhkumar in Bangladesh

4	Kaljani	Southern part of Bhutan Himalaya	Combination of Alaikura and Dima	32 km in Koch Bihar		ChoukushiBalrampur atTorsa River.	<p>Right:Pana, Gabur Basra, Buribasra, Raymatang, Garam, Doria, Gidari, Ghargharia,</p> <p>Left: NimtiJhora, Paro, ChhotoGadadhar, Nonai, Cheko, Ghungundara, Khatajani, Betra-Combined course of KhoraandNyaro.</p>	<p>* It enters into the district at South Kholta of AlipurDuar.</p> <p>* The combination of Raidak, Ghargharia, Gadadhar and Torsa is known as Dudhkumar in Bangladesh. It finally falls into the River Brahmaputra near Kurigram.</p>
5	Raidak	Chomolahari of Indo-Tibet border at the height of 7314 m.Border		R-2-47km R-1= 15		Meets with Kaljani at Balbhut.	BuraRaidak, Ghoramara, Jorai, DipaRaidak,	<p>* It is also known as Nang chu, Oyang Chu, Chin Chu, Thimpu Chu etc.</p> <p>* It enters into the district NW part of Tufanganj near Chengtimari.</p> <p>* It is divided into parts. One in the east with the name RongBarsuti, and another in the west as Raidak.</p> <p>* RongBarsuti is then falling in the river Sankosh with the name Raidak-2. At Fersabari and Falimari.</p> <p>* Tufanganj Town is situated among the Raidak-1.</p>
6	Sankosh (Gangadhar)	Northern Bhutan at the height of 6794m	Mo Chu, Puna Tsang Chu,	6km in Koch Bihar		It falls into the Brahmaputra at Assam.	Mo Chu, Pho chu, Jorai, Raidak-2, Takullya,	<p>* It enters in the district in the North-North East.</p> <p>* It demarcates the East and West Kamrup during the Reign of Maharaja Narnarayan. The eastern part is given to BirChilaray.</p>

Source: Choudhury, 1903 and Dam, M.K, 2015

Table 2.3: Average Maximum, Minimum Temperature and Rainfall of Koch Bihar

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Avg Maximum Temp °C	33.1	32.7	32.8	32.6	32.7	33.6	33.8	34.1	34.1	34.2	33.9	33.4	34.2
Avg Minimum Temp °C	15.3	15.6	15.7	14.8	17.3	17.1	16.1	18.6	16.6	16.8	16.1	14.8	15.8
Average Rainfall (cm)	21.1	23.2	26.8	25.6	27.3	18.1	21.1	30.6	30.5	40.8	26.7	33.5	27

Source: IMD, Kolkata

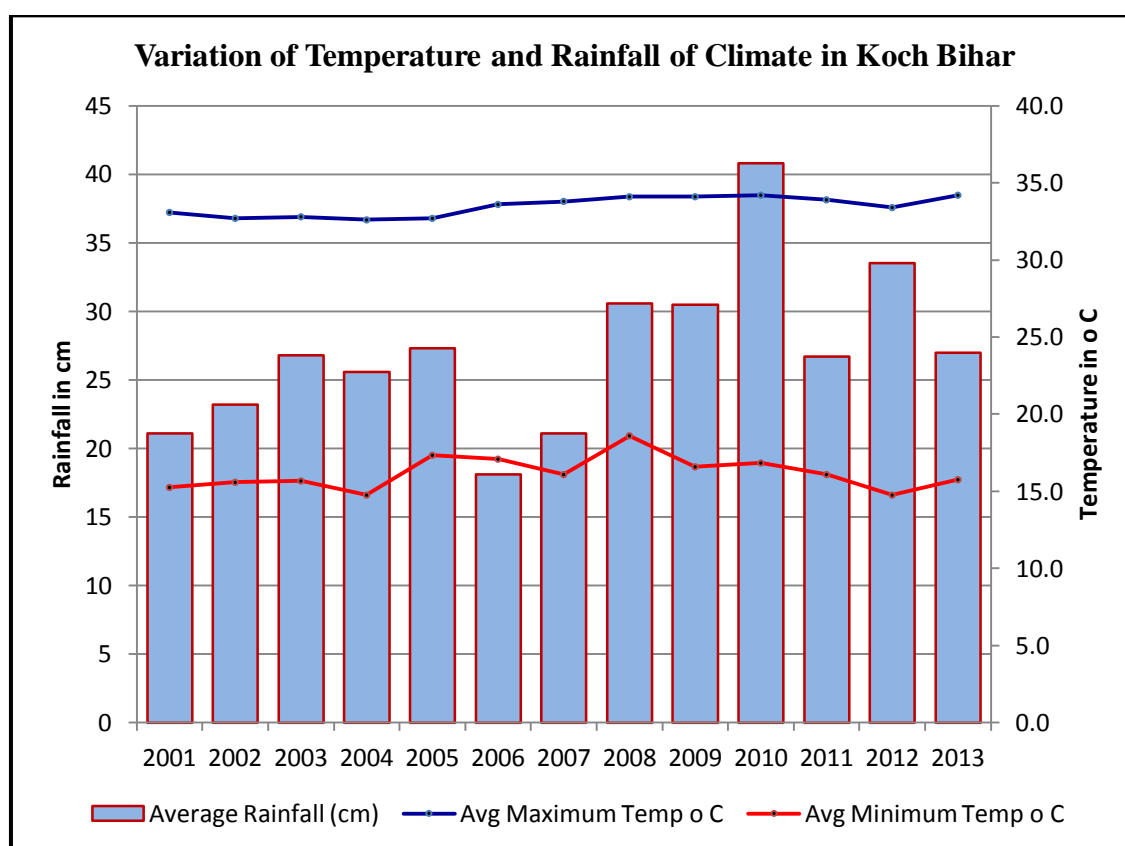


Fig 2.1: Variation of Temperature and Rainfall of Climate in Koch Bihar

Table-2.3 shows the mean daily maximum and minimum temperature in °C from 2001 to 2013. The highest temperature recorded is 38°C in the month of April of the year 2010. The maximum temperature may sometimes rise above 35°C. The fig-1.1 depicts that the mean maximum temperature was highest in the year of 2010 and lowest in the year of 2004. The highest mean minimum temperature was recorded in the year of 2008 and lowest

was recorded in the year of 2004. The figure also shows that the variation in the mean maximum temperature of the study area.

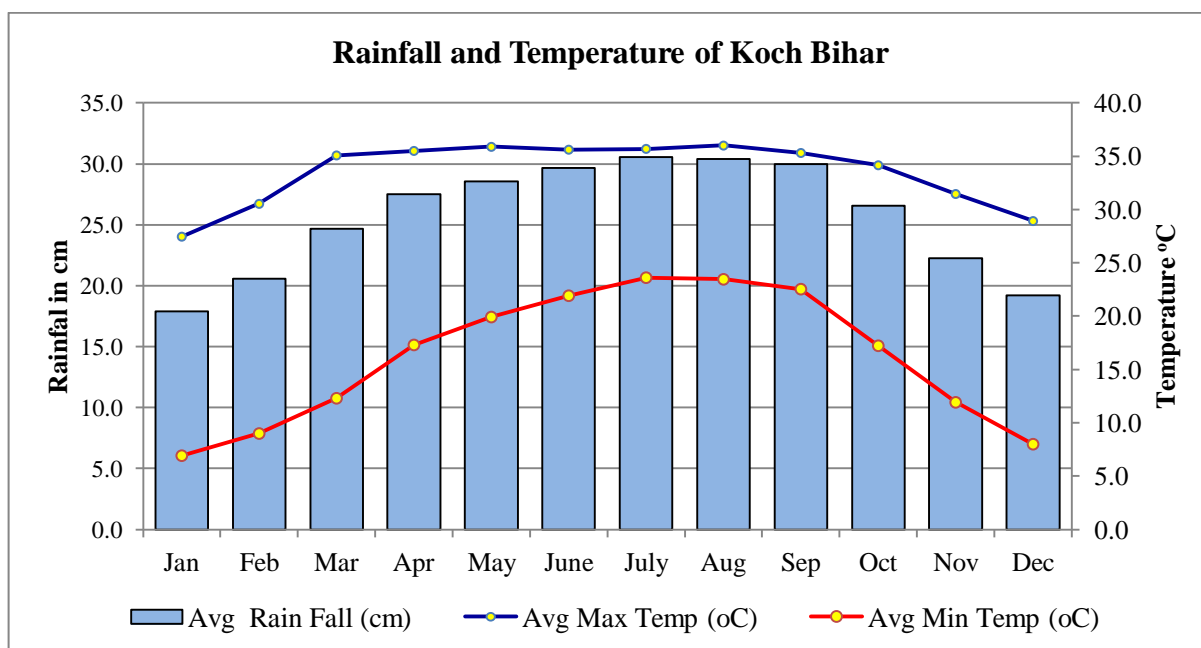


Fig 2.2: Rainfall and Temperature of Koch Bihar

The Fig-2.2 Shows that January is the coldest month in the short winter season with the lowest temperature of (6.9°C). The mean minimum temperature was also recorded in January (6.9°C) followed by December (8.0°C). The highest mean minimum temperature was observed in the month of July whereas mean maximum temperature was highest in the month of August (36° C). It was also observed that the mean maximum temperature was consistently high during the summer season.

2.4.4.2. Rainfall:

Koch Bihar has a sub-tropical monsoon with heavy downpour during the summer season. The rainfall in the winter is scanty due to depression, western disturbances and retreating monsoon. During March and April, the district witnesses *Kalbaishakhi* which is thunder storm accompanied by hail. It often damages the Zaid crops and the tobacco cultivation. Tables 2.3 and 2.4 show the maximum amount of rainfall during the summer monsoon. From the month of May to September the district receives about 88.62 % of rainfall. This huge amount of rainfall causes a recurrent flooding almost in every year. As per the Fig 1.1, the maximum rainfall occurred in the year 2010(40.8 cm) and lowest rainfall occurred in the year of 2006 (18.1 cm).

Table 2.4: Rainfall (mm) of Koch Bihar District

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
January	0	28	8	7	26	0	0	39	-	-	3	3	-
February	2	1	37	2	8	11	52	10	-	-	11	11	14
March	31	86	163	5	59	3	14	76	36	30	56	3	10
April	77	295	240	164	163	62	161	188	108	385	138	173	115
May	402	109	268	355	253	355	216	282	287	600	294	242	244
June	504	560	817	500	747	551	475	569	510	711	431	947	404
July	338	975	795	990	638	529	597	606	402	863	775	779	661
August	390	274	319	227	622	113	439	841	629	525	476	337	348
September	419	414	296	646	288	382	496	299	196	496	465	614	398
October	358	42	248	165	470	135	87	147	270	61	20	245	237
November	5	2	0	6	0	18	0	-	-	2	-	-	-
December	0	0	27	0	0	10	0	-	-	-	-	-	-

Source: IMD, Kolkata

2.4.5. Ground Water:

The district heavily depends on groundwater for domestic, industrial and irrigation purposes and so this resource is under immense pressure resulting in a decline in its water level. Due to an agrarian economy, expansion of irrigation facility is must and it can only be achieved when proper management of groundwater is made a priority.

Table 2.5: Depth of Ground Water Table

Name of the Block	Depth of Ground Water Table (m bgl)					
	Jan	April	Avg. Pre-Monsoon	Aug	Nov	Avg Post-Monsoon
Mekhliganj	2.81	3.36	3.08	1.09	1.83	1.46
Haldibari	2.48	2.96	2.72	1.30	1.65	1.47
Mathabhanga-I	3.03	3.91	3.47	1.61	2.34	1.98
Mathabhanga-II	3.68	3.72	3.70	1.73	2.42	2.07
Sitalkuchi	2.02	3.02	2.52	1.62	1.46	1.54
Koch Bihar-I	2.46	2.80	2.63	1.02	1.54	1.28
Koch Bihar-II	3.45	3.23	3.34	0.97	1.96	1.46
Tufanganj-I	4.18	4.59	4.38	2.45	3.24	2.84
Tufanganj-II	2.93	1.88	2.40	0.73	1.43	1.08
Dinhata-I	3.15	4.05	3.60	2.23	2.42	2.32
Dinhata-II	2.66	4.05	3.35	2.82	3.19	3.01
Sitai	2.50	4.36	3.43	2.05	2.88	2.46
		Mean	3.22		Mean	1.91
		SD	0.58		SD	0.63

Source: www.cgwb.gov.in (2014-15)

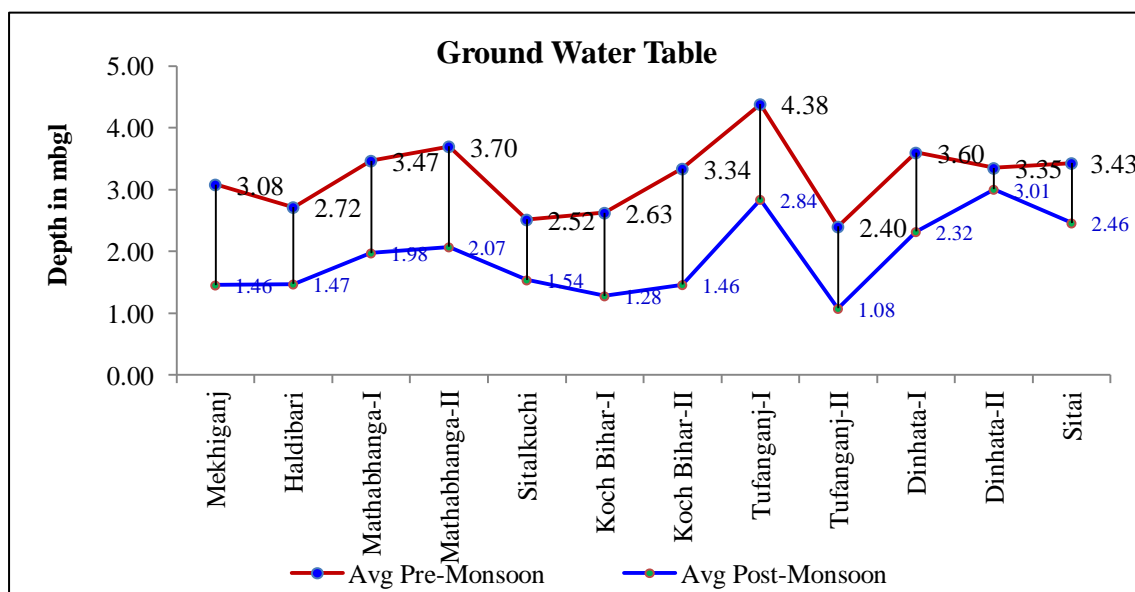


Fig 2.3: Depth of Ground Water Table

As per the records of 2014, in January the average water level varied from 0.11 to 26.93 meters below ground level (m bgl) in West Bengal. According to the report of Central Ground Water Board (CGWB), in 2011, the total ground water recharge in the district Koch Bihar was 2,31,666 Million Hectare Metre (HAM). Irrigation system is catered mainly through dug wells (1.612 sq km area irrigated), shallow tube wells (12.399 sq km area irrigated), deep tube wells (182.96 sq km area irrigated), surface lift (175.80 sq km), river lift (3.554 sq km area), tank (14.44 sq km area), and canals (121 sq km), as on 2004-05. The recharge of ground water depends on the amount and duration of rainfall and it ranges from 2.5-3.04 m bgl in Koch Bihar. Ground water is generally being developed through open wells i.e. dug wells, in the weathered zone. However, groundwater in the zone of semi-confined to confined aquifers can yield 80-170 Litres per minute (lpm) which at places goes as high as 350 lpm. From the Fig-2.2 it is observed that the depth of ground water during pre-Monsoon varies from 2.52 (Sitalkuchi) to 4.38 m bgl (Tufanganj-I) and during post-Monsoon it varies from 1.08 (Tufanganj-II) to 3.01 m bgl (Dinhata-II). Mean depth of ground water table in both seasons were 3.22 m bgl (CV= 18 %) and 1.91 m bgl (CV =33%) Table-2.5.

The chemical quality of ground water in the area is slightly acidic to slightly alkaline. The pH value ranges from 6.5 to 7.8. Iron content varies from 0.04-10.2 ppm. Fluoride concentration varies from 0.12-0.037 ppm. The average EC in the ground water in

the district is 319.4. Thus, the chemical quality of ground water in shallow and deep aquifers is safe and suitable for both domestic and agricultural purposes.

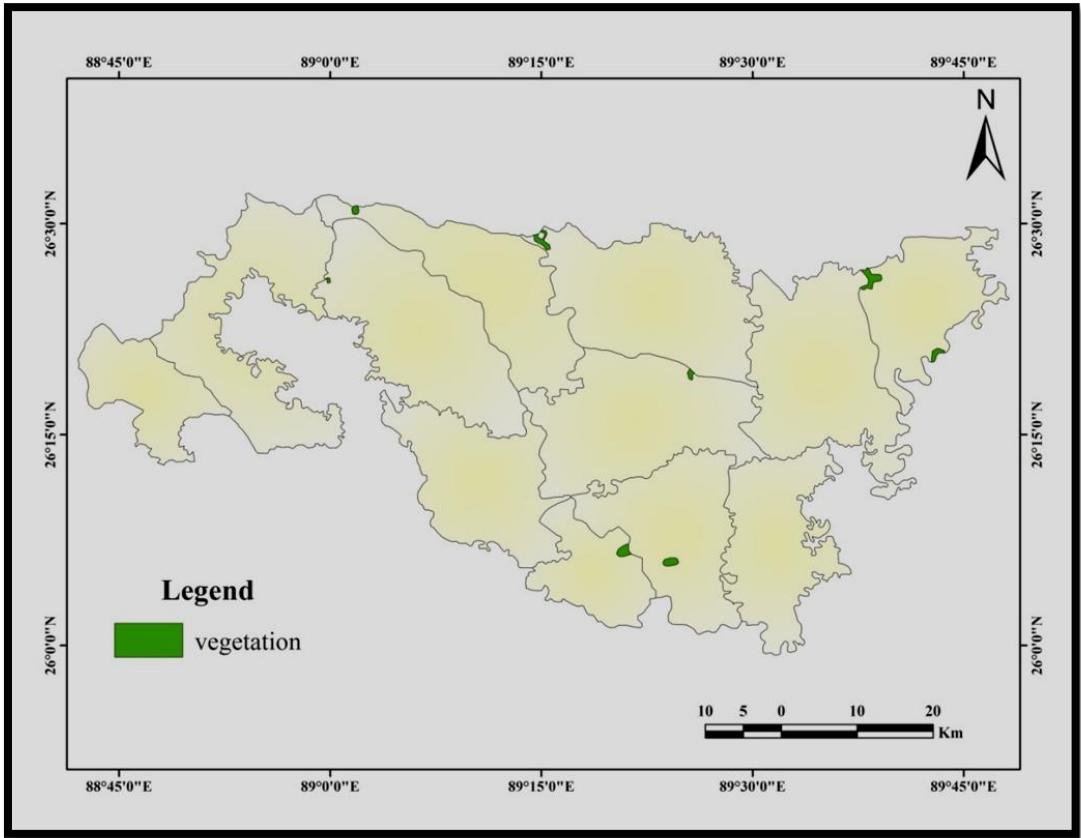
2.4.6. Natural Vegetation:

Koch Bihar district abounds in natural vegetation. Old river beds, ponds, marshes, and streams with a sluggish current have a copious vegetation of Vallisneria and other plants. Land here is subjected to inundation and usually has a covering of Tamarix and reedy grasses; and in the parts, where the ground is more or less marshy, Rosa involucrate is plentiful. Few trees occur on these inundated lands; the most plentiful and largest is Barringtonia acutangula. Among the trees, the most conspicuous is the red cotton tree (*Bombax malabaricum*); the Sissu (*Dalbergia sissoo*); Mango (*Mangifera indica*); Jack Fruit; Sal (*Shorea robusta*); Mahua; Teak; Bamboo; Khayer (*Acacia catechu*); Palms etc. Near the villages, there are usually thickets or shrubberies and more or less useful trees of a rapid growth and weedy nature. Koch Bihar district at present has no large forest patch (Table. 2.6). There are two small forests, namely Bochamari-Chengtumari forest & Patlakhawa forest. These are cleared for cultivation.

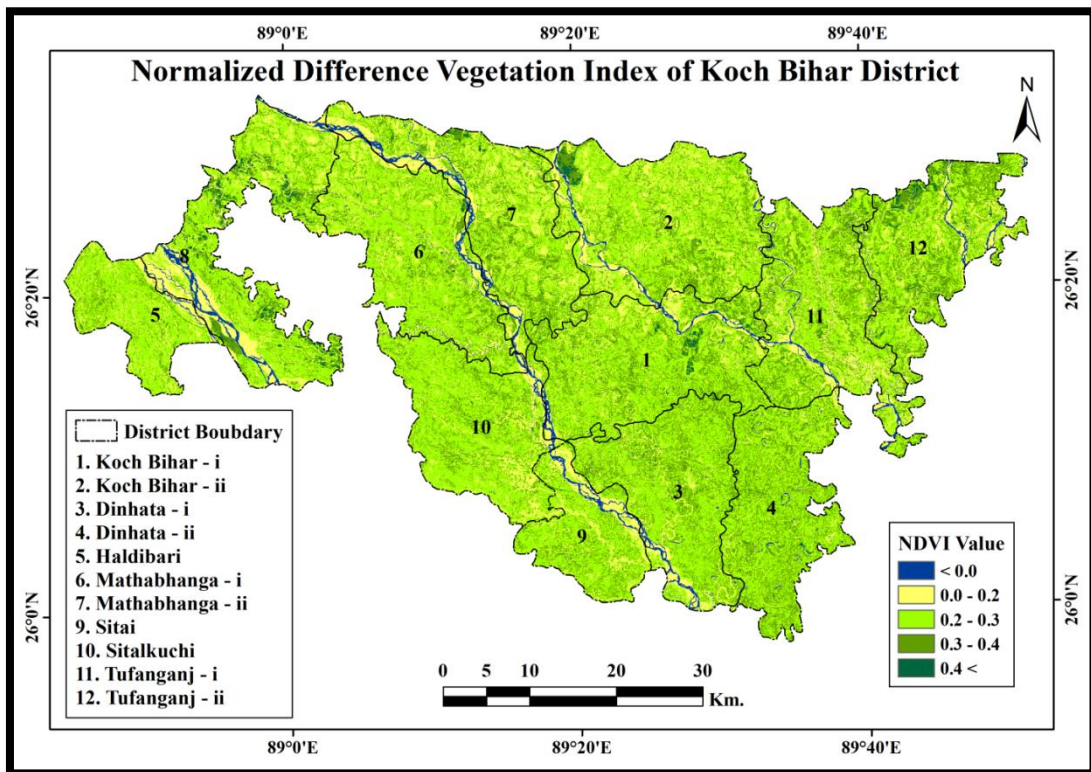
Table 2.6: District Wise Area under Forests by Legal Status in West Bengal Area in sqkm

Sl. No.	District	Reserved Forests	Protected Forests	Non-classified State Forests & Others	Total Area in Sq Km	Total Area in (Sq km)	Recorded Forest Area (Sq.Km.)	% age of Recorded Forest Area	Non-Forest Tree Cover	Total Tree Cover	% forest Cover	% Tree cover
1	Koch Bihar	-	42	15	57	3,387	57	1.68 %	764	808	1.3	23.9
2	West Bengal	7,054 (59.38 %)	3,772 (31.75%)	1,053 (8.87%)	11,879 (100%)	88,752	11,879	13.38%	9816	27281	15.7	30.7
3	All India	4,23,311	2,17,245	1,27,881	7,68,437							

Source: State Forest Report, West Bengal 2008- 2009



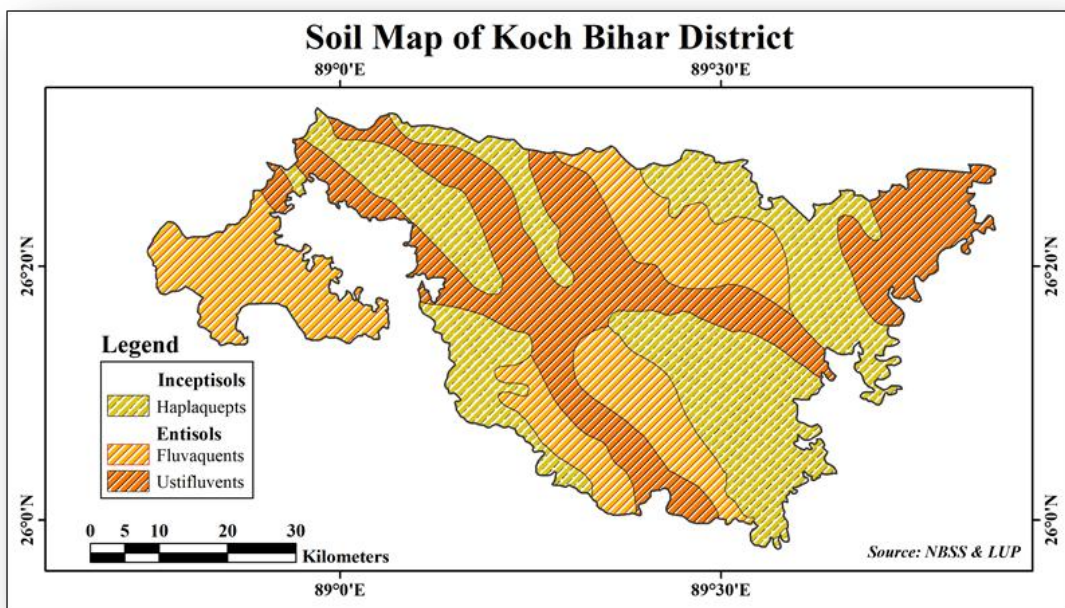
Map 2.4: Natural Vegetation Cover of Koch Bihar District



Map 2.5: Vegetation Cover Map of Koch Bihar District

2.4.7. Soil:

Soil of the study area is alluvial in nature, varying in depth from 15cm to 300cm. It is formed in the quaternary period through the sand and silt deposition, which has been carried by the rivers from Himalaya. While older alluvium soil is found far away from river courses, newer alluvium soil is found near the river and every year this newer alluvium is deposited over the low-lying areas. This soil is ideal for the cultivation of paddy, jute, tobacco, mustered oil seed etc. The turbulent water of different rivers carry huge amount of detritus material, which have an adverse effect on crop production as well as the hydrology of the study area. (Banerjee, 1984). Recurrent floods also affect the quality of the soil. The colour of the soil varies from ash to black (Census, 1977). Black soil is found in Kaljani to Sankosh River and between Jaldhaka and Dharla River. pH value of the soil varies from 5.31 -7.10 (Map-2.6). The parent rock constitutes of Igneous and metamorphic rock lies at the depth of 1000-1500 metre from the surface. The soil of the district has high water holding capacity and so the depth of the ground water table is high (1.91m bgl). The soil has a low level of nitrogen with moderate levels of potassium and phosphorus and is deficient in zinc, calcium and magnesium. The soil has high level of sulphur. The moisture retentive capacity of land in the high concentration of sulphur causes low fertility. Organic matter in recent years indicates the augmentation of consciousness among the farmers regarding utility and necessity of organic farming. The district also suffers from deficiency of micronutrient.



Map 2.6: Soil Map of Koch Bihar District

Table 2.7: Soil Texture of Different Blocks of Koch Bihar District

Sl.No.	Name of The Block	Soil Texture				USDA Classification	Soil pH
		Sand	Silt	Clay	Total		
1	MEKHLIGANJ	55.54	31.29	13.17	100.00	Sandy Loam	6.50
2	HALDIBARI	69.68	21.72	8.60	100.00	Sandy Loam	6.18
3	MATHABHANGA-I	43.96	40.08	15.96	100.00	Loam	5.83
4	MATHABHANGA-II	53.71	31.26	15.03	100.00	Sandy Loam	6.50
5	SITALKUCHI	61.10	27.72	11.18	100.00	Mixed	5.31
6	KOCH BIHAR-I	42.12	45.78	12.10	100.00	Loam	7.10
7	KOCH BIHAR-II	44.53	47.24	8.23	100.00	Loam	6.47
8	TUFANGANJ-I	32.15	36.70	31.15	100.00	Clay Loam	6.25
9	TUFANGANJ-II	51.92	29.19	18.89	100.00	Mixed	5.88
10	DINHATA-I	42.38	43.24	14.38	100.00	Loam	7.25
11	DINHATA-II	48.86	36.27	14.87	100.00	Loam	6.40
12	SITAI	51.57	32.57	15.86	100.00	Sandy Loam	6.51

Source: Soil Testing Lab, Koch Bihar

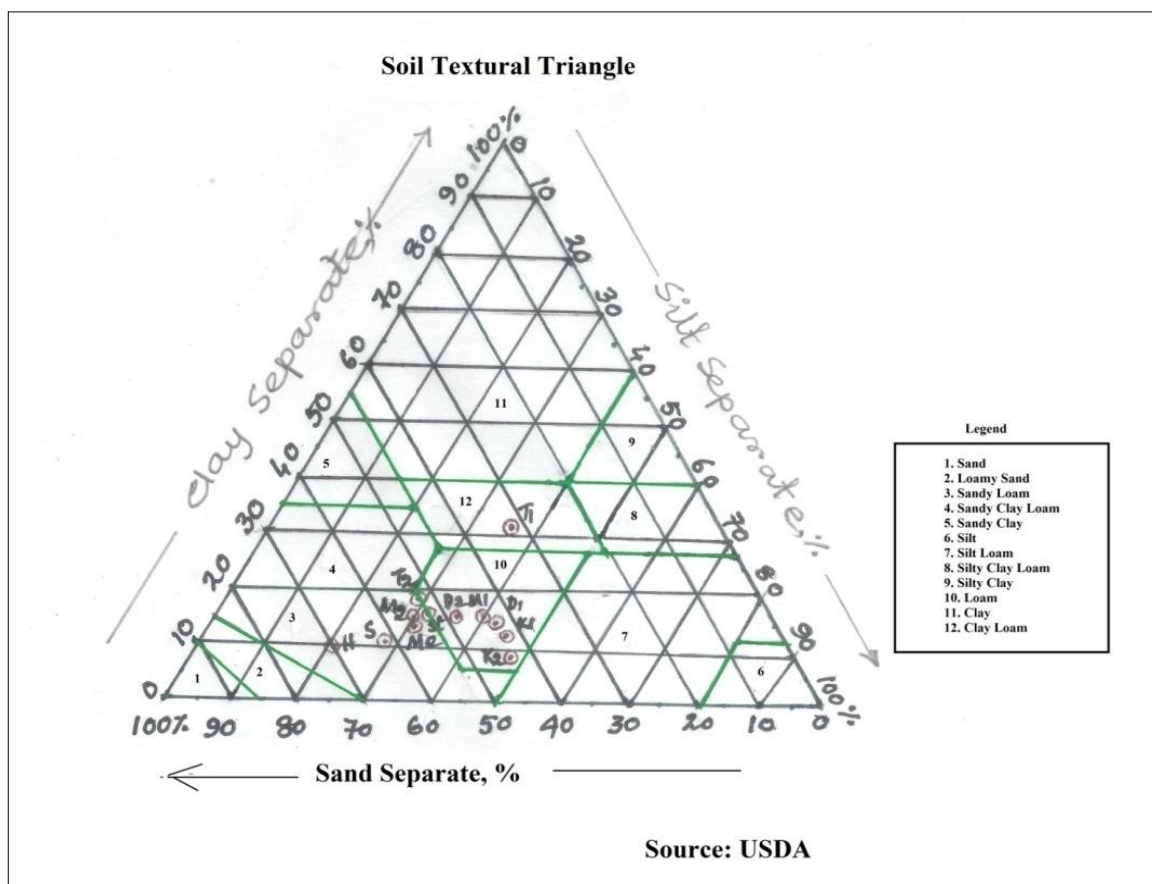


Fig 2.4: Ternary Diagram Showing the Soil Texture in Koch Bihar District

The soil is generally acidic in nature, because of heavy rainfall and greater gradient. The soil is highly leached. Sheet erosion is a problem in the areas of tea plantation in the district. Sandy-loam soil is found in Mekhliganj, Haldibari, Mathabhanga-I and Sitai Block. Loamy Soil is found in Mathabhanga-I, Koch Bihar-I, Koch Bihar-II, Dinhata-II, and Dinhata-I. The textural classification of Tufanganj-I is Clay loam (Table-2.8) which is suitable for brick making as well as agriculture. The soil of Sitalkuchi and Tufanganj-II blocks is mixed in nature.

There are four soil series in the study area namely- Lotafela, Matiarkuthi, Rajpur, and Balrampur series as classified by NBSS & LUP, 2001 Publication No-89. Out of which three series are observed in Koch Behar Sadar and Tufanganj subdivision. A brief description of the 3 soil series is incorporated in the following table-2.8.

Table 2.8: Soil Classification of the Study Area

Name of the Series	Location	USDA Classification	Physiographic position	Elevation	Horizon	Nature
Matiarkuthi	Sadar (East and Central)	Coarse-Loamy, mixed, hyperthermic, Aquic, Ustifluvents	Indo-GangeticTista Plain, Recent alluvial plain	40-50m above MSL	AP, AB, 2C1, 2C2, 2C2,	Gently sloping (1-3%), Imperfect Drained and rapid permeable; Land Capability Sub-class: VI; Irritability: 4d; Productivity potential: Low
Rajpur	Extensive part in Koch Bihar Sadar	Fine-Loamy, mixed, hyperthermic, Aeric, Endoaquaeps	Indo-GangeticTista Plain, Recent alluvial plain	40-50m above MSL	AP, Bw1, Bw2, Bw3, Bw4	Level to nearly level sloping (0-1%), Imperfectly drained, and moderate to slow permeable ; Land Capability Sub-class: III; Irritability: 2S; Productivity potential: Low to Medium
Balrampur	Tufanganj	Fine-Silty, mixed, hyperthermic, Typic, Fluvaquents	Indo-GangeticTista Plain, Recent alluvial plain	60-70 m above MSL	AP, AC, C1, C2, C3, 2C4,2C5	Level to nearly level sloping (0-1%), Imperfectly drained, and moderate permeable ; Land Capability Sub-class: IIw; Irritability: 2d; Productivity potential: High

Source: NBSS & LUP, 2001 Publication No-89

2.5: Socio-Economic Background:

The Socio-cultural setting of the area under study has been discussed under demographic characteristics, ethnic and economic composition.

2.5.1: Demographic Characteristics:

The 2011 census points out that in terms of the population size, Koch Bihar district stands 17th in the state. With a total area of 3387 sq km, this district accommodates 3.08% of the state's total population and ranks 11th among other districts of West Bengal in respect to population density, indicating that the pressure of the population on the land is moderately high. As per census 2011, Koch Bihar's total population was 2,819,086, which shows a 13.8% in decennial growth rate (Table-2.9). In pre-independence period, the population of this area registered a negative growth due to several occurrences of epidemics. Since 1951, an unprecedented rate of growth was recorded mainly due to a huge influx of immigrants from Bangladesh. Although from 1991 onwards growth rate has started declining. The table Table 2.9 presents the nature of population growth in Koch Bihar district.

Table 2.9: Population Growth of Koch Bihar District

Year	Population Koch Bihar	Decadal Growth (%)	Population WB	% to state's total Population	Rural Population	% to district's total	Urban Population	% to district's total
1901	565116	---	1,69,40,088	3.34	5,51,056	97.51	14,060	2.49
1911	591012	4.58	1,79,98,769	3.28	5,75,218	97.33	15,794	2.67
1921	590599	-0.07	1,74,74,348	3.38	5,73,338	97.08	17,261	2.92
1931	589053	-0.26	1,88,97,036	3.12	5,71,023	96.94	18,030	3.06
1941	638703	8.43	2,32,29,552	2.75	6,11,882	95.80	26,821	4.20
1951	668949	4.74	2,62,99,980	2.54	6,18,769	92.50	50,180	7.50
1961	1019806	52.45	3,49,26,279	2.92	9,48,360	92.99	71,446	7.01
1971	1414183	38.67	4,43,12,011	3.19	13,17,531	93.17	96,652	6.83
1981	1771643	25.28	5,45,80,647	3.25	16,49,383	93.10	1,22,260	6.90
1991	2171145	22.55	6,80,77,965	3.19	20,01,648	92.19	1,69,497	7.81
2001	2479155	14.19	8,01,76,197	3.09	22,53,537	90.90	2,25,618	9.10
2011	2819086	13.71	91276115	3.09	25,29,652	89.73	2,89,434	10.27
					Average	94.10	Average	5.90

Source: District Census Hand Book

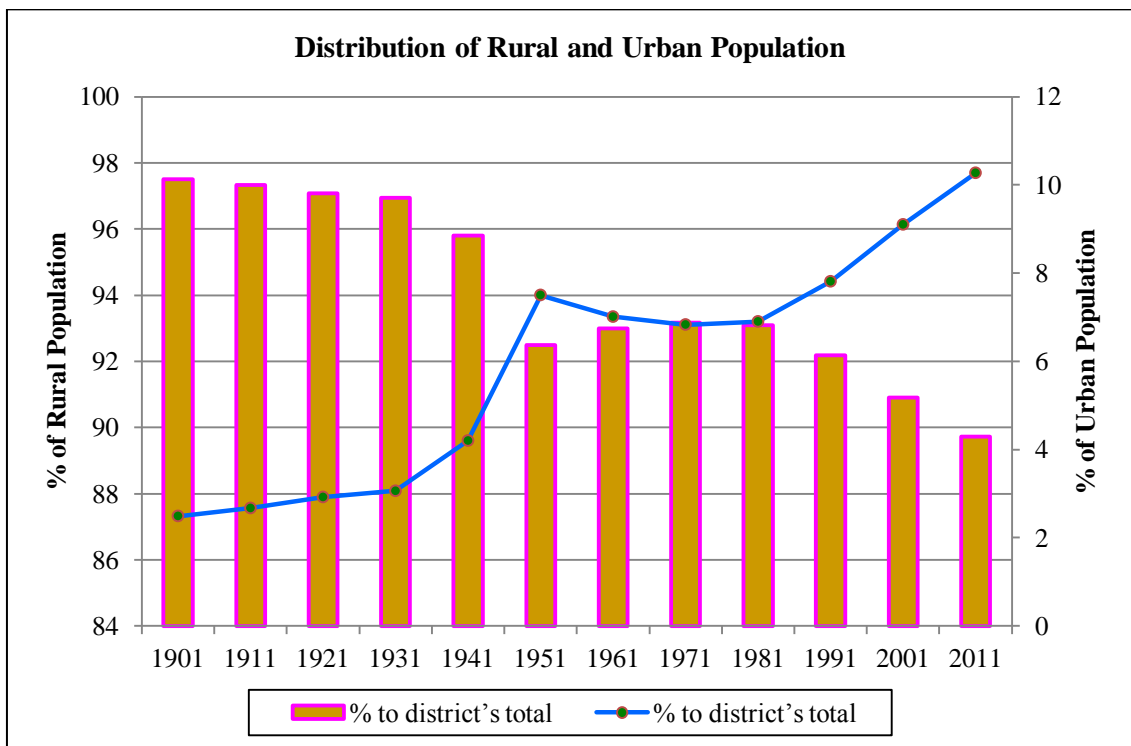


Fig 2.5: Distribution of Rural and Urban Population

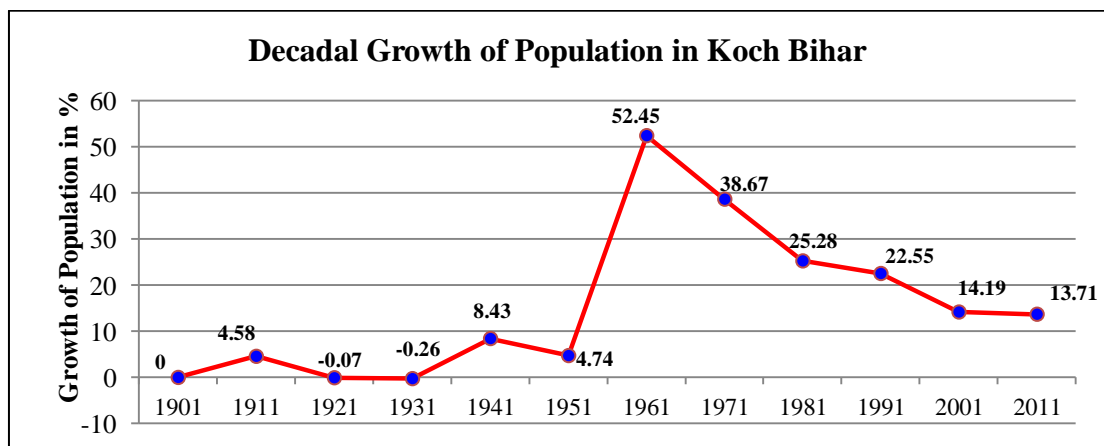


Fig 2.6: Decadal Growth of Population in Koch Bihar

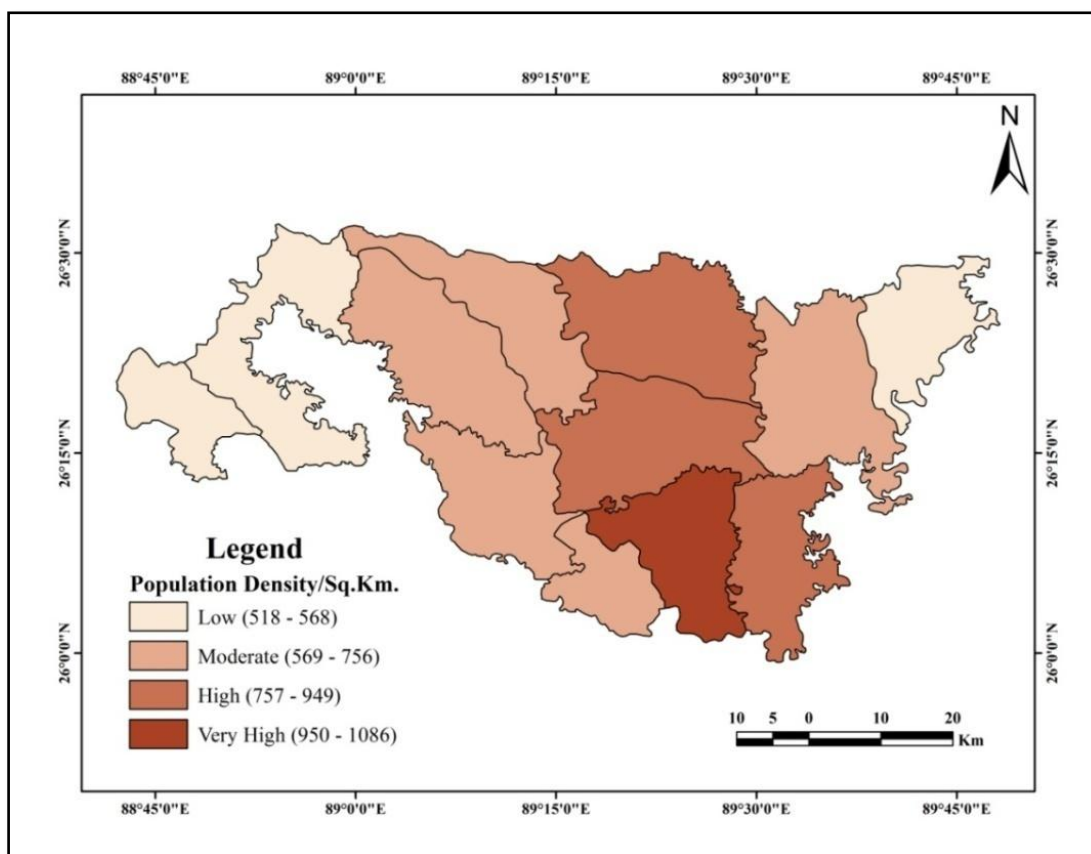
This district is predominantly rural in nature. The average share of the rural population is 94.10% and the average urban population is 5.90%. As per 2011 census, 89.73 % population of Koch Bihar districts lives in rural areas. Out of 2,529,652 rural populations, the number of males and females are 1,304,916 and 1,224,736 respectively. In rural areas of Koch Bihar district, sex ratio is 939 females per 1000 males. The child sex ratio of Koch Bihar district is 949 girls per 1000 boys. Child population in the age 0-6 is 319,225 in rural areas of which males are 163,815 and 155,410 are females. The child population comprises 12.55 % of the total rural population of Koch Bihar district. From the year 1901, there is an

increasing urbanization trend with the highest growth rate observed during 2001-2011. Gradually increasing urban population and the number of census towns from 2001 to 2011 (Fig- 2.6) give a clear indication of rapid urbanization trend though the growth rate is slower than the other districts of West Bengal.

The Average Sex ratio of the district was 942 females/ 1000males whereas in West Bengal it was 950. The sex ratio has increased steadily after 1951 which may be considered as the most significant demographic change. Table 2.10 shows that Sitai block has the highest sex ratio (970) followed by Sitalkuchi (966). The Lowest Sex Ratio is observed in Dinhata-I Block (840). The average density of population in the district was 748 persons/sq.km (Table-2.10) whereas during 2011 census the average density of population in the West Bengal state was 1028 persons/sq km. The highest density was observed in Dinhata-I (1086) (Map- 2.7).

Table 2.10: Block Wise Population of Koch Bihar District (2011)

Name of the Block	Area Sq Km	Male	Female	Sex Ratio	Total	Density km/sq km	
Koch Bihar – I	375.32	1,68,185	1,58,373	942	3,26,558	870	
Koch Bihar – II	362.36	1,79,591	1,64,310	915	3,43,901	949	
Dinhata – I	250.00	1,47,602	123935	840	2,71,537	1086	
Dinhata – II	293.11	1,26,663	1,17,403	927	2,44,066	833	
Haldibari	200.70	52,851	51,118	967	1,03,969	518	
Mathabhanga - I	312.96	1,12,497	1,05,694	940	2,18,191	697	
Mathabhanga - II	313.84	1,17,100	1,10,297	942	2,27,397	725	
Mekhliganj	292.42	80,052	75,198	939	1,55,250	531	
Sitai	151.25	56,016	54,317	970	1,10,333	729	
Sitalkuchi	261.60	94,277	91,076	966	1,85,353	709	
Tufanganj – I	328.62	1,28,415	1,20,180	936	2,48,595	756	
Tufanganj – II	328.62	96,222	90,504	941	1,86,726	568	
Source: District Census Hand Book, Koch Bihar, 2011				Average	942	Average	748
				WB	950	WB	1028



Map-2.7: Population Density Map of Koch Bihar, 2011

2.5.2. Literacy Status and Sex Composition:

This district is placed at the 10th position in terms of state's literacy level. It is presently 74.48% in 2011, which is 1.59% less than the state average. The low level of literacy indicates the backwardness of the district. The male-female literacy level also shows great variation; the male being much lower than the female.

Table 2.11: Sex Ratio and Literacy Rate of Koch Bihar District

Year	Sex Ratio		Percentage of Literacy	
	Koch Bihar	West Bengal	Koch Bihar	West Bengal
1901	881	945	5.9	9.8
1911	873	925	7.4	10.8
1921	877	905	7.8	12.3
1931	886	890	6.6	12.4
1941	879	852	NA	19.7
1951	855	865	15.0	24.61
1961	890	878	21.00	34.46
1971	916	891	21.92	38.86
1981	935	911	30.10	48.65
1991	935	917	45.80	57.70
2001	949	933	66.30	68.64
2011	942	950	74.78	76.26

Source: District Census of India

But there has been a sharp 11.45% increase in the female literacy rate of 2001 (Table-2.11), which again confirms the improvement in the status of the females. The following table shows the trend of sex ratio and a literacy rate of the district in the last six decades.

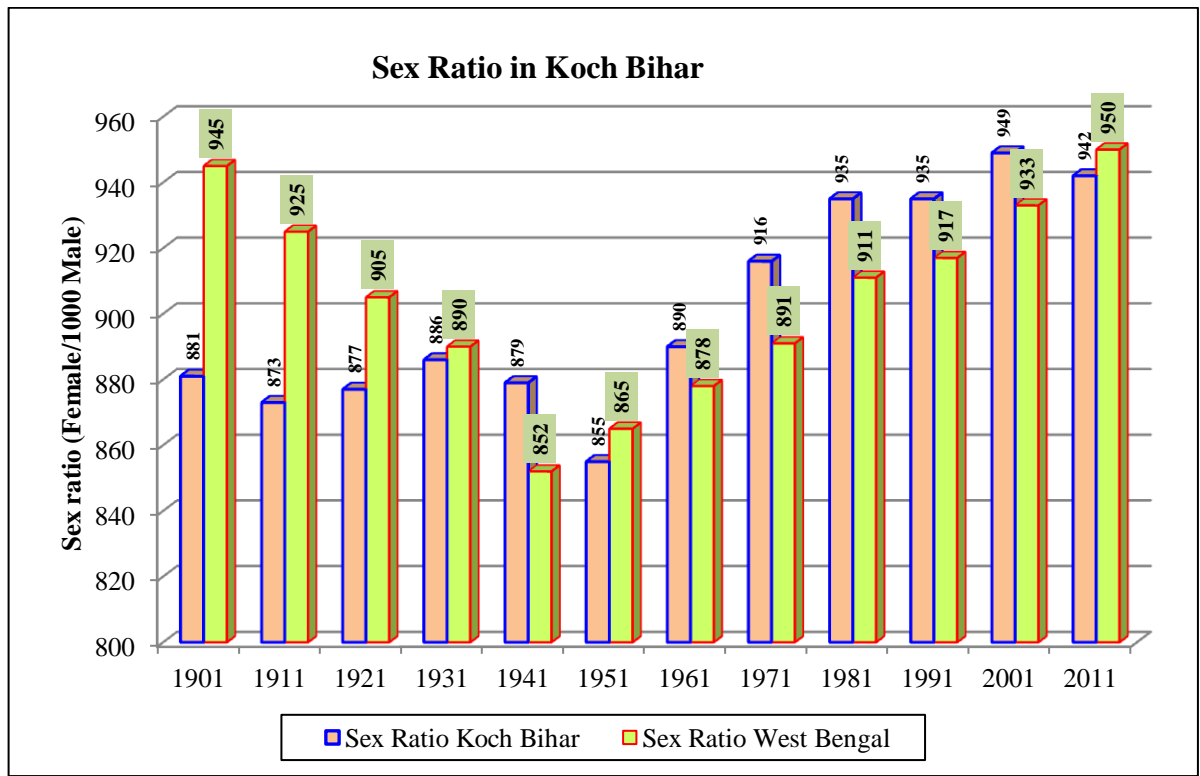


Fig 2.8: Sex Ratio in Koch Bihar

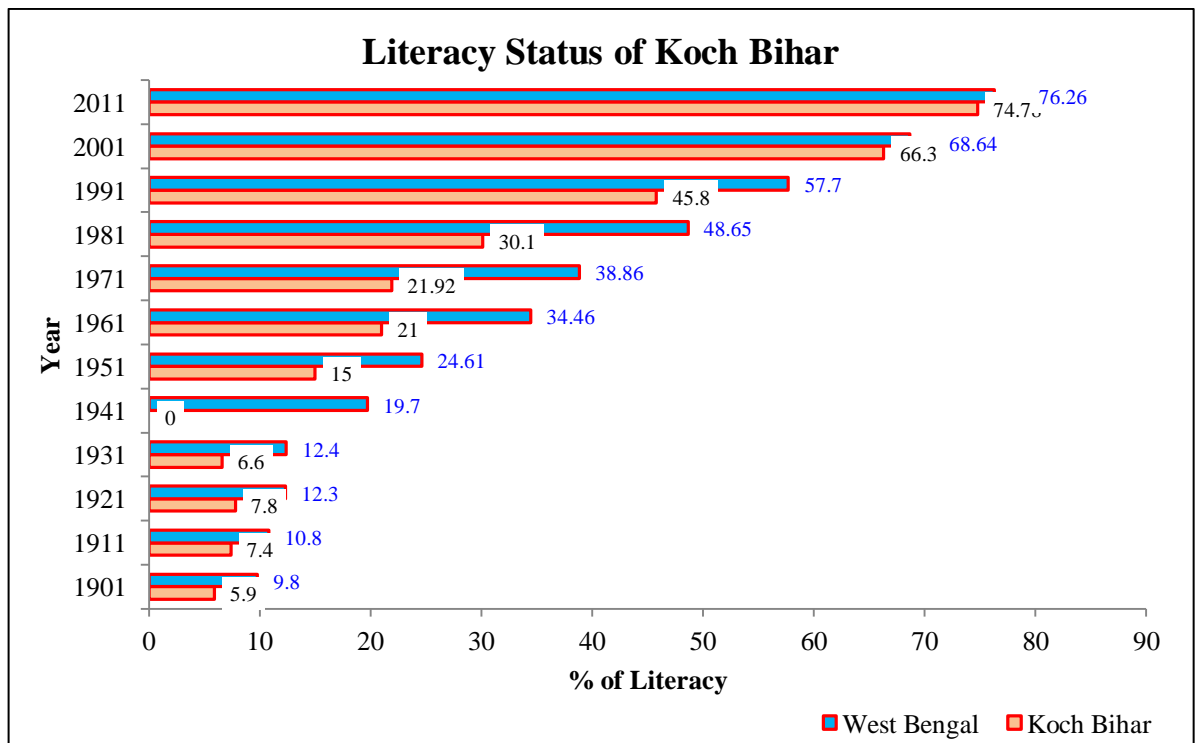


Fig 2.9: Literacy Status of Koch Bihar

2.5.3. Religion and Caste Composition:

About half of the total population (50.2%) belongs to the scheduled castes and a negligible portion belongs to the scheduled tribes (0.60%). This is caused due to the nature of the ethnic composition of the district. Koch Bihar district contains the largest number of SC population in West Bengal. The table shows that over the years there is a hike in SC population, while the ST population is decreasing. Rajbanshis – the single largest hinduised social group, followed by the Namasudras are the majority among scheduled caste population. The majority of the tribal population is constituted of Oraon, Rabha, Munda, Santal, Bedia and Garo. Muslims constitute the second largest (25.54% in 2011) religious group of population in the district (Table 2.12).

Table 2.12: Religion and Caste Composition

Year	SC	% to total	ST	% to total	Hindu	% to total	Muslim	% to total	Others	% to total
1981	883084	49.84	10105	.57	13,99,844	79.01	368176	20.78		
1991	1123719	51.76	13273	.60	1,659,733	76.44	506728	23.34	4684	.22
2001	1242374	50.11	14246	.54	187,1857	75.50	600911	24.24	5648	.23
2011	1,414,336	50.2	18,125	.60	2,087,766	74.06	720,033	25.54	7033	.27

Source: Census of India

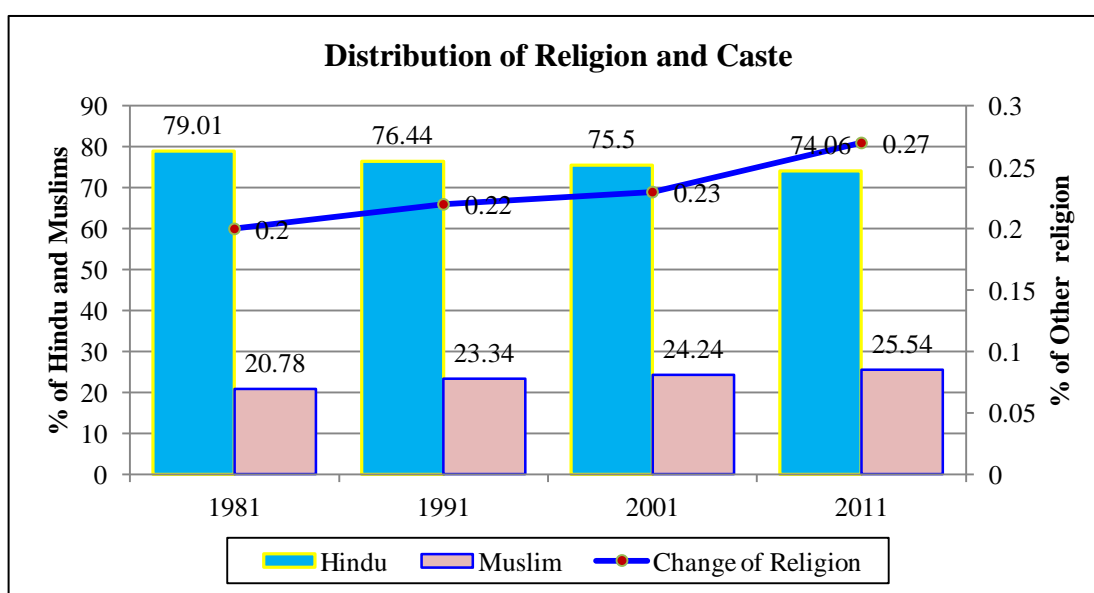


Fig 2.10: Distribution of Religion and Caste

2.5.4. Occupational Structure:

Occupational structure is defined as the distribution of working force among various sectors of economic activity. Working force is referred to the population engaged in various productive activities in an economy.

The percentages of male and female workers were 54.91% and 22.22 % with respect to the total male and female population in 2001 (Table-2.13). However, in 2011, the percentage of male workers increased to 58.24 % and the percentage of female workers declined to 20.67 % (Fig-2.11).

Table-2.13: Working Population

Place	Persons		Male		Female	
	2001	2011	2001	2011	2001	2011
Koch Bihar	2479155	2819086	1272094	1451542	1207061	1367544
Total Worker	966705	1127977	698550	845308	268155	282669
Percentage (%)	38.99	40.01	54.91	58.24	22.22	20.67
Tufanganj-I	223088	248595	113796	128415	109292	120180
Total Worker	76418	100657	60927	76376	15491	24281
Percentage (%)	34.25	40.49	53.54	59.48	14.17	20.2

Source: Census, 2001 and 2011

Table-2.14: Percentage of Population Distribution over Different Categories of Workers & Non-Workers in the District of Koch Bihar (As Per Census, 2011)

Name of the Block / Municipality	Total Population	[all figures in percentage (%) to respective Total Population]							
		Cultivators	Agricultural Labourers	Household Industrial Workers	Other Workers	Total Workers	Main Workers	Marginal Workers	Non-Workers
Koch Bihar-I	326558	27.9	32.37	5.44	34.34	41.21	30.96	10.25	58.79
Koch Bihar-II	343901	21.4	33.77	3.04	41.85	37.31	30.85	6.46	62.69
Koch Bihar (M)	77935	0.9	0.83	1.94	96.33	35.16	31.39	3.77	64.84
Koch Bihar Sadar	748394	22.4	30.01	4.04	43.51	38.79	30.96	7.83	61.21
Tufanganj-I	248595	24.7	34.95	9.94	30.42	40.49	31.19	9.31	59.51
Tufanganj-II	186726	28.7	33.82	5.77	31.72	39.77	29.5	10.26	60.23
Tufanganj (M)	20998	1.06	0.61	7.96	90.36	35.78	33.28	2.51	64.22
Tufanganj	456319	25.4	33.07	8.16	33.42	39.98	30.59	9.39	60.02
District Total	2819086	32.3	34.74	3.6	29.32	40.01	31.44	8.57	59.99

Source: Census of India, 2011, Note: Total Workers = Main Workers + Marginal Workers

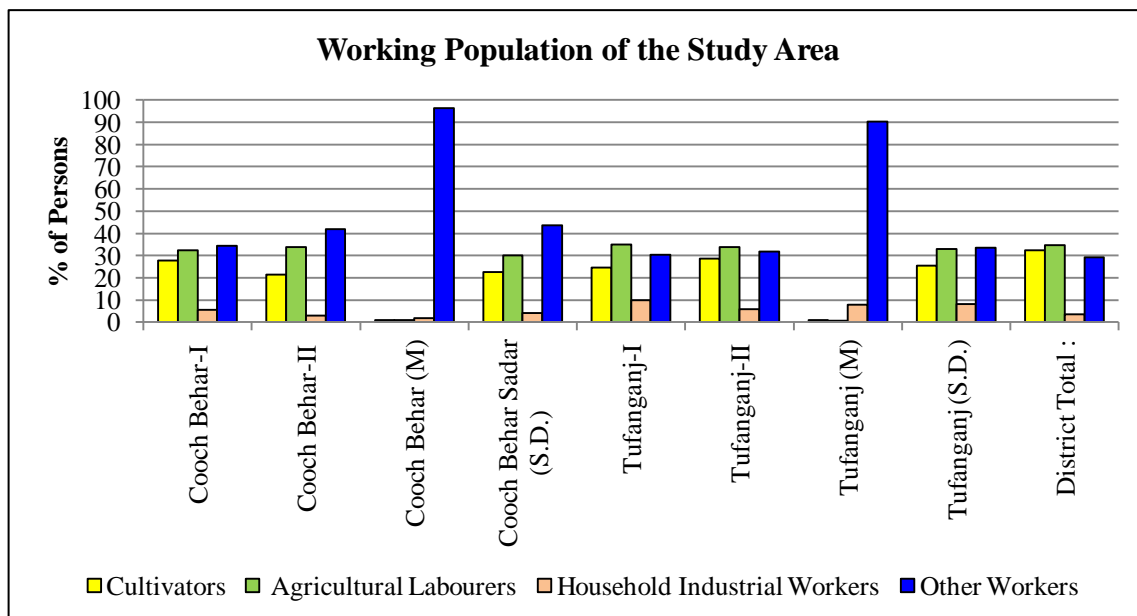


Fig 2.11: Working Population of the Study Area

The different categories of working population of the study area have been diagrammatically represented in Fig 2.11. The statistics on population composition of Koch Bihar district reveals that the percentage of workers (main and marginal) is only 31.44% and 8.57% (Census 2011), against a significant proportion of about 60% non-workers. Hence, the burden of the dependent population is high and which is also indicative of a limited scope for employment opportunities in the district. The occupational composition shows a large proportion of primary sector workers. About 77.18% of workers are cultivators and agricultural labourers, whereas only 3.8% of workers are engaged in household industries and 29.32% are engaged in other industrial and service sectors (Table-2.15) and Fig- 2.12.

Table 2.15: Percentages of Different Categories of Working Population in Koch Bihar

Category	1981	1991	2001	2011
A. Main Worker	28.99	30.56	30.4	31.44
1.Cultivators	15.03	14.72	37.4	32.34
2.Agri. Labourer	7.90	7.96	29.5	34.74
3.Household Industry	0.58	0.71	4.1	3.60
4. Other Workers	5.43	7.17	29.0	29.32
B. Marginal Worker	0.81	1.59	8.6	8.57
C. Non-Worker	70.20	67.85	61.0	59.99

Source: DCHB, Koch Bihar

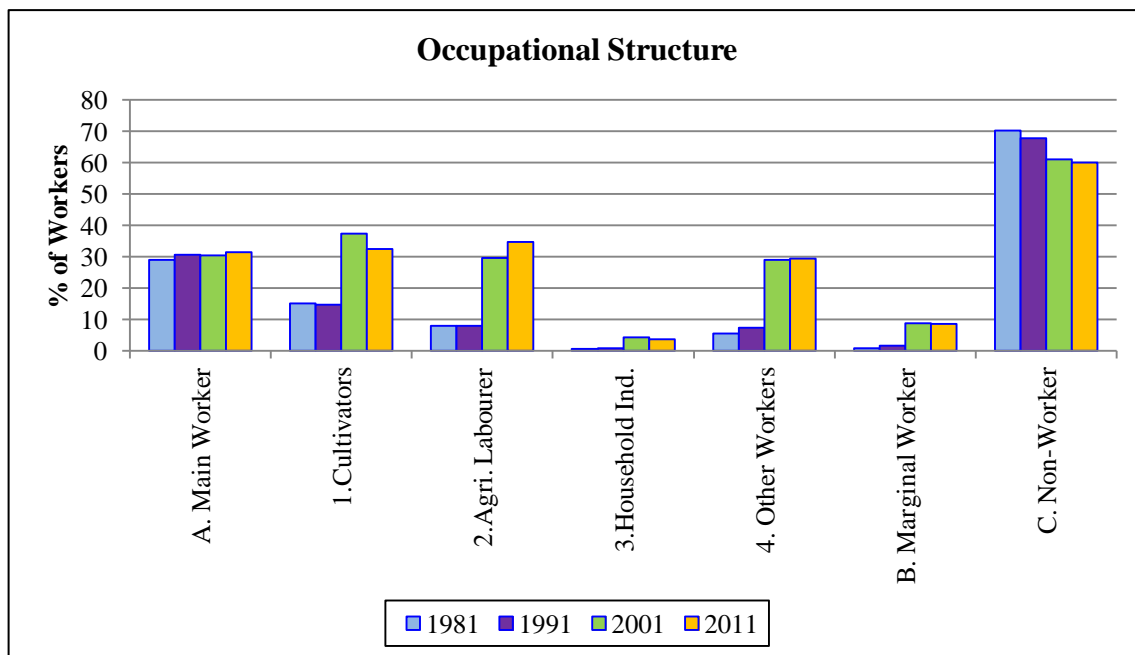


Fig 2.12: Occupational Structure

The fall in the number of cultivators, during the decade 2001-11 from 58.2% to 55% has been identified (Census, 2011). But the district witnessed a significant rise of cultivators during last 3 decades as against the national trend of declining number of cultivators. Simultaneously, the slight increase in the number of industrial workers indicates an expansion in industrial activities. Overall, the gradual rise in the proportion of industrial activities indicates a gradual sectoral shift in the economy of the district, though it still relies on farm-based activities leaving the identity of the district as rural in particular.

2.5.5. Infrastructural Facilities:

The role of infrastructure in the economic development of any area is immense. Hence an understanding of the study area in the light of the availability of infrastructural facilities is very crucial. Moreover, it also helps in determining the quality of life of the inhabitants, which could have an influence on health and sanitation of the people under study. The following table gives information on the distribution of educational institutions in Koch Bihar district.

Table 2.16: Distribution of Educational Facilities in Koch Bihar District (2011-12)

Schools	College	University	Technical school	Technical College	Technical University	Non- formal institutions
2180	15	1	28	14	1	4847

Source: District Census hand Book, 2011

The district provides primary level education in almost all the rural and urban areas, the number (210) in Koch Bihar II block. The number of secondary (101) and higher secondary schools (159) is less in terms of the total population of the district.

An analysis of the health care facilities available for the inhabitants of the district reveals that 400 bedded district hospital plays a focal role in the health care scenario. There are 4 sub-divisional hospitals in sub-divisional headquarters of Koch Bihar Sadar, Dinjata, Mekhliganj and Mathabhanga. The district is also endowed with a few special hospitals like Mental Hospital (1), TB hospital (1), Cancer hospital (1) and Leprosy hospital (1). The private nursing homes also operate within the district and are mainly located in the sub-divisional towns with maximum concentration in Koch Bihar Sadar area. In Koch Bihar district Ayurvedic and Homeopathic treatments are also very popular. The relative cheaper cost of medicine, age old practice and lack of side effects are the few reasons for wide scale preference for such treatment methods. The following table shows the distribution of medical institutions in (2011) Koch Bihar district.

Table 2.17: Categories of Medical Institution Available in Koch Bihar District (2011)

DH	H	RH	BPHC	PHC	FWC	SC	Blood Bank	N.H (reg.)	Urban FWC	Ayurvedic Shops	Homeo. Clinic and shops
1	4+4	1	12	38	33	406	3	15	3	15	21

Source: District Census hand Book, 2011

According to census report (2011), 89.93% of villages under Koch Bihar district avail medical facilities. The secondary level facilities are concentrated only in urban areas of Koch Bihar Sadar and other 3 sub-divisional blocks. The absence of tertiary level care implies lack of specialised medical facilities in the district. The total number of beds (2052) and that of doctors (278) in terms of the total population of the district indicate a gloomy health care scenario.

Table 2.18: Availability of Amenities in Villages (%) of Koch Bihar District (2011)

Total Villages	Drinking water	P.O.	Telephone	Power	Pucca Road	Transport
1132	99.03	24.20	86.84	100	49.47	32.42

Source: District Census Hand Book, 2011

Apart from educational and medical facilities, other amenities available within the district include safe drinking water, sanitation, power supply, transport and communication. From the table below, it can be concluded that in terms of power supply and access to safe drinking water facility, the villages under Koch Bihar district are well placed (with 100% power supply and near to 100% drinking water facility). The proportion of villages having telephone facility (86.84%) is also very high, however the villages lag far behind in enjoying the facilities of Post offices (24.20%), transport and communication (32.42%) and access to Pucca road (49.47%) (Table 2.18). Interestingly, the district is well connected with internet and mobile network services, which leaves a better prospect for introducing mobile health technology in health care services of the district.

2.5.6. Conclusion:

From the preceding discussion, it seems that the area under study has many advantages in terms of availability of fertile agricultural lands, rich natural and agricultural resources, developed agro-based industries and satellite connectivity. The district is also not at a disadvantage position in terms of literacy rate. Yet, according to West Bengal Human Development Report (2004), the district is placed at the lower rung (HDI 0.52; HDI rank 11th) in terms of human development index which indicates that the district is not favourably positioned on certain spheres of economy. The health care facility too in the district is inadequate to meet all needs of the people in the district. Moreover, lack of industries and poor transport connectivity indicates backwardness of the district, which demands governmental interventions for a better prospect.

References:

1. Blaeu, J. (1664). "Novus Atlas Sinensis. [Map]". In Blaeu Atlas Maior (Vol. 10).
2. Census of India (2001-2011): West Bengal Census Office, Calcutta, Series 23, Part XIII, A and XIII-B.
3. Chowdhury, H.N. (1903). "The Koch Bihar State and its Land Revenue Settlement", Edited by Dr. Nripendra Nath Pal, (2010), Published by N. L. Publishers, Siliguri.
4. Dam.M, 2016. "River and Wetland of Koch Bihar" Ganga Publication, Kolkata,1-179.
5. Debnath, S. (2008). "Essays on Cultural History of North Bengal." N.L. Publishers, Siliguri.
6. District Census handbook, Koch Bihar, 1901-2011

7. District Statistical Hand Book (2001-2011), Bureau of Applied Economics and Statistics (2001 to 2013), Government of West Bengal.
8. District Statistical Hand Book (2011). Bureau of Applied Economics and Statistics. Government of West Bengal.
9. Economic Review (2000-01). Government of West Bengal, Statistical Appendix, Calcutta.
10. Economic Review (2010-11): Government of West Bengal, Statistical Appendix, Calcutta.
11. <http://censusindia.gov.in/>
12. http://www.asikolkata.in/Publications_files/excavation_rajpat-98-2k.pdf
13. <http://www.dehoopsteenwerwe.co.za/>
14. Mazumder, D.D. (1977). West Bengal District Gazetteers: Koch Bihar, Government of West Bengal. 9-12.
15. Mead, W. E. (1969). "Geography and area studies. In Trends in Geography: An introductory Survey", ed. R. U. Cooke and J. H. Johnson, 247–52. Oxford, UK: Pergamon.
16. Monthly Weather Report (2001-2011), Indian Meteorological Department, <http://www.imd.gov.in>.
17. Monthly Weather Report (2001-2011), Indian Meteorological Department, <http://www.imd.gov.in>
18. Sarkar, J N (1992), "Chapter IV: Early Rulers of Koch Bihar", in Barpujari, H. K., The Comprehensive History of Assam, 2, Guwahati: Assam Publication Board.
19. Statistical Abstract (2000): Government of West Bengal, State Statistical Bureau, Calcutta.
20. Statistical Abstract (2001-2011): Government of West Bengal, State Statistical Bureau, Calcutta.
21. The Gazette of India-Ministry of Environment and Forests (1999), Part I- Sec 3 Subsection (II) New Delhi.