CHAPTER-I

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1. 1. Introduction:

Manufacturing of brick is one of the most important village industries that falls in the category of unorganized sector in Indian economy. It is one of the significant bases of modern civilization. The basic needs of the human being are food, cloth and shelter. After procurement of food and cloths, they try to acquire permanent shelter. At the beginning people were wandering to and fro as in the form of nomads. With the advent of art of growing crops from soil, the origin of agriculture took place which abruptly changed the course of livelihood pattern and people settled in a particular place permanently especially at the vicinity of river valley. Thus, most of the human civilizations were established along the river valleys such as Maya, Mesopotamian, Harappa and Mohenjo-Daro etc. As time went by, human being was gradually capable to use permanent house from cave to modern shelter. This led the people to construct the permanent structures. Introduction of the use of brick makes the civilization more significant. The process of urbanization was paced after the Industrial revolution in 1770A.D. The procrastination of urbanization makes the use of bricks in faster rate. The population explosion and rapid urbanization led to increase of use of bricks in various fields. The contemporary industrialization and economic development all over the world also act as a pivotal role in the development of construction industry in the developed as well as underdeveloped countries.

India produces 250 billion bricks annually from 1,40,000 brick kilns, employing about 15 million workers and consuming about 35 million tons of coal annually (Wanjule et.al., 2015). The current production of bricks in the world is about 1391 billion units (Freedonia, 2012). India's share of brick production is second (17.97%) followed by China (54%). This sector is growing at a faster rate in India (9% annually). The brick sector in India consumes about 24 million tons of coal every year. The brick industry is the 3rd largest sector in the consumption of coal (after power and iron and steel industry) which accounts for 3% of total coal production as well as 1.45 % of total coal consumption respectively in India.

1.2. A Brief History of Brick Making:

Human civilization started with the use of stone and use of bricks by the human being has a long back history. The dried bricks were used for the first time in 8000 BC and fired clay bricks were used as early as 4500 BC (Pacheco et.al. 2011). The historians discovered that the first sun dried brick was used in and around 7000B.C at Southern Turkey. The evidences of sundried bricks were also traced in Egypt, Mesopotamia (around 5000 B.C) Harappa and Mohenjo-Daro (2500-1500 B.C). The spread of the use of bricks started from the ancient civilization to modern civilization towards India, China and Mediterranean region. The emperor of the Romans also knew the use of bricks. The use of bricks in China is traced back about 3800 years back in China by Xian and in 3000 years ago the Zhou dynasty used the bricks. The Great Wall of China was made by Qin Shi Huang in 259-210 B.C. (http://www.dehoopsteenwerwe.co.za). The history of brick making has been traced back in India also in the monuments of Sarnath (3rdcentury B.C to 11th century AD), Nalanda in 4th - 12 century AD, Qutub Minar in 12th-13th Century AD. The Mughal emperors also used the fired brick. (India Report on Brick, 2016).

At the earlier stage bricks were made by hand. The introduction of brick in Virginia was by the Dutch and British immigrants in 1611(https://brickarchitecture.com). The use of brick has been paced from the great fire of London in 1666 AD and rebuilding of the Act of 1667. Modern Brick in India was introduced in Jeppu (near Mangalore) in 1865 by Plebst. The first evidence of the use brick in Koch behar was observed in Kamteswar garh (mound) at Gosanimari, SW of Dinhata subdivision. The excavation by the Archaeologist proved by Carbon dating of the remnant of the brick is 910 ± 10 AD.(ASI,1998-2000). In Koch Bihar district, a special type of brick was used by 'Koch' dynasty in British period. The First traditional kiln Prasad Brick Field (PBF) was set up in the present study area (Maruganj of Tufanganj-I block) in year of 1965. This was the clam type kiln. Before setting up the modern brick factories, there were many *'Tali Bhata'* that existed in this district. This type of *'bhata'* was operated by '*Kumars'* who are *'Pal'* in sub-title.

At present, there are 40 registered operating brick kilns in Koch Bihar out of which 24 kilns are located in Tufanganj Block-I (60%). 6 kilns are located in Mathabhanga-I, 6 kilns in Koch Bihar-I, 3 in Tufanganj-II and 1 is located in Sitai Block.

1.3. Statement of the Research Problem:

India's total geographical area is 328.73 million hectares and total land area is 297.32 million hectares. Out of the total land area in India, only 159.59 million hectares' area is available for cultivation. (http://agcensus.nic.in). In India about 55 % or more workers are engaged in agricultural activities (263 million) (Census, 2011). As per Economic census 2015-16, the share of agriculture of India's GDP is 17.4 %. But, as mentioned in the earlier that India has produced 250 million bricks per year. It causes a serious problem of land degradation especially loss of top soil. If the size of a brick is taken as 10 inches X 5 inches X 3 inches, and a depth of 2 feet is quarried for making the bricks, the total loss of land per year would be about 93 thousand hectares; this is a serious concern in developing countries like India.

In terms of environmental pollution, the brick sector plays a vital role as most of the kilns in India are fixed chimney Bull's trench type. They emit CO, CO_2, NOx, SOx, $PM_{2.5}$, PM_{10} and create environmental pollution. As mentioned earlier the brick sector is the 3rd largest consumer of the coal and brick sector consumes about 24 million ton of coal. Due to inferior technology and low grade coal and improper combustion the brick kiln sector is made inefficient. Further, brick manufacturing causes land degradation which also causes water logging, removal of top soil and produces a huge amount of solid waste. An estimate reveals that 4.16×10^{18} ton top soil is being removed every year. It causes about 93×10^3 hectares of land degradation in every year.

According to the census 2011, there are 481.7 million workers in India. About 15 million (3.11%) workers, both male and female, are engaged in brick kiln sector. According to the census classification of workers, the workers in the brick kiln sector have been treated as unorganized sector. The living and working conditions of the workers are miserable. Most of the cases the labour laws are violated either in terms of wage or working hours. It is evident that the workers are exploited by their employers. Another serious problem encountered in this sector is the engagement of child labourers who are not registered in most cases. From various studies it is also evident that the brick manufacturing sector in almost all the states of India employs migrant labourers. They are worst sufferers with lower wage rate, inhuman living and working conditions. The migration has been international (Nepal), National (inter-state), intra-state, intra-district. Whatever may be the nature of migration, the education of the children of the migrant labour is hampered. According to the NSSO (2011-12, Round-68, Table-S36), agriculture sector generates 48.9% employment though the people

who are engaged in agriculture and allied sectors are discouraged as these sector fails to generate work throughout the year. Moreover, the brick manufacturing is the seasonal activity and it creates an opportunity to earn lump sum amount in a short period of time. In the lean period of agricultural activities, the people migrate with their family members towards the brick kiln industry. Thus, indepth study of the nature of migration associated with the brick manufacturing industry is of utmost significance.

The technology of brick manufacturing varies from Clam kiln to modern tunnel to vertical shaft Brick kiln. But in India, the Fixed Chimney Bull's Trench Kiln (FCBTK) is the most popular firing technology for burning the bricks. About 70% brick kilns in India are FCBTK type. The FCBTK technology is the most inferior technology as it is less energy efficiency and more polluting tendency. Its Specific Energy Consumption (SEC) is 1.0-1.4 MJ/ kg of fired bricks as compared to VSBK (.75-1.0MJ/ kg of fired bricks. (GKSPL, 2016). Moreover, it is more polluting than VSBK. Thus, the technological transfer for firing the bricks may be treated as a serious concern.

Another aspect of brick manufacturing is that the marketing facilities and availability of finance are not free from constraints. The brick sector is required a huge amount of capital from setting up of the kiln to run the industry. The cost of establishment of brick firing technology varies from 1 million to 2.5 million rupees and total cost involved in brick making varies from rupees 50-60 lakh per season. As it is yet an unorganized sector, the accumulation of finance for an entrepreneur is a big task. The banking sector does not show proper interest for giving loans to the owner. Thus, the owner gather finance from own capital, money lender and sometimes take advance from the promoters and businessman on condition of extreme higher rate of interest and selling of bricks in lower price. Proper marketing of bricks may be considered in this regard.

As per financial report the, India has targeted an average annual growth rate of 9% and the rate of urbanization is being faster with a decadal growth of 31.8 during 2001 to 2011(Planning Commission,2011). The towns and cities have been increased 3768 to 7951 during this period (Census of India, 2011). Further, it was also estimated that the construction sector will grow at 6.6% during 2005-2030. This creates a heavy demand of about 500 million bricks every year by 2030. This huge demand of bricks requires setting up new plants, modernizing the existing technologies. The top soil may be replaced by Fly-Ash-Lime-Gypsum (FAL-G) or other raw materials.

Keeping in the above points in mind the present study has been taken into consideration for exploring the facts of brick manufacturing in Tufanganj Block-I of Koch Bihar.

1.4. Rationale of the Study:

The brick kilns of the study are located in between Koch Bihar Sadar and Tufanganj Town at Maruganj region. These kilns are located 12-15 km from Koch Bihar and Tufanganj and within 6km radius of Maruganj region. The concentration of such kilns causes the environmental problems in the study area. Moreover, Agricultural land is becoming degraded day by day. The agglomeration of brick kilns in the study area generates employment opportunity to the local as well as the adjacent and migrated people. There is a need for review of the status of socio-economic, living and working conditions of the workers involved in the industry. Hence the present study on '**SOCIO-ECONOMIC AND ENVIRONMENTAL IMPACT OF BRICK KILN INDUSTRY IN TUFANGANJ BLOCK I OF KOCH BIHAR DISTRICT, WEST BENGAL– A GEOGRAPHICAL ANALYSIS**' has been taken up.

1.5. Scope of the Study:

The scope of the study are--

i. Brick fields constantly are emitting smoke with hustle and heat, which play negative impact on environment.

ii. Brick fields engulf agricultural land and infertile the soil and reduce productivity of the land.

iii. Heaps of clay, sand and gravel pits, ash of brick kiln, and loss of top soil have caused the health and agricultural hazards.

iv. Brick field is the catalyst of changing micro –climate by creating heat belt.

v. The work and workforce, women, child, migrant and local workers are facing miserable condition.

vi. It affects the social and cultural backwardness of the kiln area.

vii. Economy is affected by the brick factory.

viii. Low living standards, marginal working condition, poverty, indebtedness, illiteracy, exploitation of workers etc. are common in brick field area.

1.6. Objectives of the Study:

The following objectives are to be taken into consideration

i. To describe the factors of location of brick kiln industry in the study area of the district.

ii. To assess living and working environment as well as socio-economic condition of the brick kiln workers.

iii. To analyze the marketing and financial condition of brick kiln industry

iv. To study the impact of brick kilns on environment.

1.7. Hypotheses:

In order to study the problems related to brick kiln industry in Koch Bihar district the following hypotheses have been adopted.

i. The agricultural land and environment are being deteriorated due to the expansion of brick kiln industry to the adjacent area.

ii. The conditions of working environment and those of workers living standards are miserable.

iii. Brick kiln industry creates seasonal job opportunity and has a positive impact on economy.

1.8. Database and Methodology:

Methodology is one of the prime criteria for the inner base of research. The methodology of the present study is to be followed in the following ways:

To describe the study area on physical features, Topographical Maps, Satellite imageries, District planning series map are used the secondary data from various sources

such as District Census Hand Book, District Gazetteer, District Statistical Hand Book, District Agricultural Annual Plan, data from B.L& R.O and D.L& R.O office have been used to describe the socio-economic characteristics of the study area. Environmental data from the concerned department have been collected and analyzed for describing the environmental status of the study area.

The primary data have been collected by using Stratified Random Sampling and size of sample may be varied up to 30 percent to 60 percent. Soil samples, water samples have been collected and the amounts of SOx, NOx, CO2, and Suspended Particulate Matter data have been collected in order to test the environmental status.

Moreover, the study used the questionnaire / schedules as a source of data. Interactions with the workers, brick field owner, the local people, Panchayet personnel, and other officials associated directly or indirectly with the subject concerned have been interviewed.

Finally, the findings of the entire work have been interpreted and analyzed partly manually and partly by using computer.

1.9. Choice and Selection of Sample Size and Sample Design:

The present study has been carried out in the brick kiln cluster in Tufanganj Block –I which constitutes 72 Mouzas covering an area of 78150.42 acres. Out of 72 mouzas, brick kilns are located in 6 Mouzas (area 7060.72 acre) in and around Maruganj Village which is located in between Koch Bihar Sadar and Tufanganj town 12 in each direction. Only 8.33% mouzas and 9.03 % of total area of Tufanganj-I have been covered by Brick kiln in the study area. In Koch Bihar district there are 40 brick kilns out of which 24 (60%) are located in Tufanganj-I Block. From these 10 (approximate 40%) kilns are selected on the basis of Stratified Random Sampling method. Samples are taken according to the area covered by the kilns and categorized into Large (>20 Acre), Medium (10.1-20Acre) and small (<10.0 Acre). Each category has been selected purposefully so that the sample is covered by each mouza according to their proportion. Thus, sample is covered by each mouza. Total area covered by the selected sample is 181.52 Acre (about 50% to total Kiln area).

Table-1.1: Area of Brick Kilns in Different Mouzas

SL No	Name of Brick Kiln	Maradanga	Soladanga-II	Velakopa-II	Ghogarkuthi-I	Chilakhana	Shikarpur	Total land
1	SARADA	8.12	0	0	0			8.12
2	VELAKOPA	11.71		3.58	0			15.29
3	NEW MARADANGA	11.58	0	0	0			11.58
4	SURJA(MAYUR)	11.58	0	0	0			11.58
5	SONA	10.41	0	0	0			10.41
6	VIVEKANANDA	14.29	0	0	0			14.29
7	GOPINATH	0	11.62	0	0			11.62
8	BENGAL	0	7.24	2.68	0			9.92
9	NOTH BENGAL-I	18.97	0	0	0			18.97
10	NOTH BENGAL II	12.91						12.91
11	INDIA-I		0	21.28	0			21.28

12	INDIA-II	5.5		8.87				14.37
13	KOCH BIHAR	12.3	0	1.25	0			13.55
14	SARAN (HBMC)	2.72	0	0	0			2.72
15	MADAN/ MOHAN-I	78.29	0		0			78.29
16	MADAN/ MOHAN-II	9.9						9.90
17	SAHA I	0	0	0		9.44		9.44
18	SAHA II	0	0	0		7.73		7.73
19	DELUX	0	0	0	9.14			9.14
2	SUMANA I				18.95			18.95
21	SUMANA II	0	0	6.63	15.23			21.86
22	SUN (JYOTI)		0	0	7.49		5.65	13.14
23	RRS I				4.11			4.11
24	RRS II	0	0	0	12.21			12.21
Total Area Under Brick Kilns (Acre)		208.28	18.86	44.29	67.13	17.17	5.65	361.38
Total (Nos)		12	2	2	5	2	1	24
Total Area of the Mouza (Acre)		1810.00	285.54	442.89	2757.20	1475.07	290.02	7060.72
% to Total Mouza Area		11.51	6.61	10.00	2.43	1.16	1.95	9.03
% To Total Kiln Area		57.63	5.22	12.26	18.58	4.75	1.56	100.00

Source: Field Survey, 2015-16

Table-1.2: Selection of Sample Unit on the Basis of Size of the Kiln

SL No	Area in Acre	Name	Mouza	Land area (Acre)	% to Total Kiln Area
1	<10.0	Saran	Maradanga	2.72	6.75
2		RRS-I	Ghogarkuthi-I	4.11	
3		Sarada	Maradanga	8.12	
4		Saha-I	Chilakhana	9.44	
5	10.1-20.0	Gopinath	Soladanga-II	11.92	15.93
6		Sun (Jyoti)	Shikarpur	13.14	
7		Koch Bihar	Maradanga	13.55	
8		Sumana-I	Ghogarkuthi-I	18.95	
9	>20.0	India-I	Velakopa -II	21.28	27.55
10		Madan Mohan-I	Maradanga	78.29	
			Total	181.52	50.23

Source: Field Survey, 2015-16

A detailed survey of all the kiln owners (proprietors) (24 Kilns) was done with pre-tested questionnaire for determining the production, financial status, sales of product, cost of production, profit analysis etc. In this regard some secondary data are used to analyze the marketing situation of the bricks.

A sample of 364 has been selected purposefully among the brick kiln workers from different category in sampled kilns (10 kilns) to collect the information about the living and working and socio-economic conditions of the workers. For this purpose, 10 to 20 % samples from male and female workers were taken from each category of workers.

Table-1.3: Total Workers in the Different Kilns

Category of Labour	SARADA	VELAKOPA	NEW MARADANGA	SURJA(SJBF)	SONA	VIVEKANANDA	GOPINATH	BENGAL	NOTH BENGAL I	NOTH BENGAL II	INDIA I	INDIA II	COOCH BEHAR
SL No	1	2	3	4	5	6	7	8	9	10	11	12	13
Pathera	90	67	40	85	87	81	90	70	90	50	70	35	90
Other Moulder	24	20	10	22	20	22	24	20	25	15	20	10	25
Loader (Rejin)	132	100	60	125	130	119	132	100	132	80	107	52	132
Unloader (Paka Bagdar)	102	80	45	95	100	92	102	80	100	60	80	40	100
Munshi	4	4	4	4	4	4	4	4	4	4	4	4	4
Sardar	2	2	2	2	2	2	2	2	2	2	2	2	2
Coalmen	4	4	4	4	4	4	4	4	4	4	4	4	4
Firemen	4	4	4	4	4	4	4	4	4	4	4	4	4
Manager	1	1	1	1	1	1	1	1	1	1	1	1	1
Night Guard	2	2	2	2	2	2	2	2	2	2	2	2	2
Accountant	1	1	1	1	1	1	1	1	1	1	1	1	1
Daily Labour	5	5	5	5	5	5	5	5	5	5	5	5	5
Total	370	290	178	350	360	336	370	293	370	228	300	160	370

Source: Field Survey, 2015-16

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Table- 1.3. Total Workers in the Different Kilns

Category of Labour	SARAN(HBMC)	MADAN/ MOHAN I	MADAN/ MOHAN II	SAHA I	SAHA II	DELUX	SUMANA I	SUMANA II	SUN (JYOTI)	RRS I	RRS II	Total
SL No	14	15	16	17	18	19	20	21	22	23	24	
Pathera	50	92	82	100	90	88	128	85	96	50	70	1,875
Other Moulder	15	25	25	25	25	25	35	28	25	15	20	519
Loader (Rejin)	80	136	135	145	135	130	190	130	140	70	110	2,801
Unloader (Paka Bagdar)	60	110	105	100	107	100	144	100	110	55	86	2,153
Munshi	4	4	4	4	4	4	4	4	4	4	4	96
Sardar	2	2	2	2	2	2	2	2	2	2	2	48
Coalmen	4	4	4	4	4	4	4	4	4	4	4	96
Firemen	4	4	4	4	4	4	4	4	4	4	4	96
Manager	1	1	1	1	1	1	1	1	1	1	1	24
Night Guard	2	2	2	2	2	2	2	2	2	2	2	48
Accountant	1	1	1	1	1	1	1	1	1	1	1	24
Daily Labour	5	5	5	5	5	5	5	5	5	5	5	120
Total	228	386	370	393	380	366	520	366	394	213	309	7,900

Source: Field Survey, 2015-16

Table-1.4: Total Workers in the Selected Sample Unit

Category of Workers	SARAN(HBMC)	RRS II	SARADA	SAHA I	GOPINATH	SUN (JYOTI)	COOCH BEHAR	SUMANA I	INDIA I	MADAN/ MOHAN I	Total
Pathera	50	70	90	100	90	96	90	128	70	92	876
Other Moulder	15	20	24	25	24	25	25	35	20	25	237
Loader (Rejin)	80	110	132	145	132	140	132	190	107	136	1,303
Unloader (Paka Bagdar)	60	86	102	100	102	110	100	144	80	110	994
Munshi	4	4	4	4	4	4	4	4	4	4	40
Sardar	2	2	2	2	2	2	2	2	2	2	20
Coalmen	4	4	4	4	4	4	4	4	4	4	40
Firemen	4	4	4	4	4	4	4	4	4	4	40
Manager	1	1	1	1	1	1	1	1	1	1	10
Night Guard	2	2	2	2	2	2	2	2	2	2	20
Accountant	1	1	1	1	1	1	1	1	1	1	10
Daily Labour	5	5	5	5	5	5	5	5	5	5	50
Total	228	309	370	393	370	394	370	520	300	386	3,640

Source: Field Survey, 2015-16

Table-1.5: Selection of Sample Size of the Different Types Workers

Name of the Sample Unit	Mouza	Total Worker	Total Sample Size (10%)	Male (%)	Female (%)
Saran	Maradanga	228	23	13	10
RRS-II	Ghogarkuthi-I	309	31	18	13
Sarada	Maradanga	370	37	21	16
Saha-I	Chilakhana	393	39	20	19
Gopinath	Soladanga-II	370	37	20	17
Sun (Jyoti)	Shikarpur	394	39	21	18
Cooch Behar	Maradanga	370	37	20	17
Sumana-I	Ghogarkuthi-I	520	52	28	24
India	Velakopa -II	300	30	17	13
Madan Mohan	Maradanga	386	39	22	17
	Total	3640	364	200	164
	Total (%)	100	100	55	45
Source: Field Survey, 2015-16					

Table-1.6: Sex Wise Different Sample Size of the Workers

Type of Labourers/ Workers		Pathera		Other Moulder		Loader (Rejin)		Unloader (Paka Bagdar)		Munshi	Sardar	Coalmen	Firemen	Manager	Night guard	Accountant	Daily labour		Sample Size (10%)
Name of the Kiln	Sex	Male	Female	Male	Female	Male	Female	Male	Female	Male	Male	Male	Male	Male	Male	Male	Male	Female	
Saran		2	2	1	1	4	3	4	3	1				1				1	23
RRS-II		4	3	1	1	6	5	5	4	1			1						31
Sarada		5	5	2	1	7	6	5	4		1				1				37
Saha-I		5	5	1	1	7	7	5	5			1				1		1	39
Gopinath		5	4	1	2	7	6	5	5			1				1			37
Sun (Jyoti)		5	4	1	1	7	8	6	5			1			1				39
Cooch Behar		5	4	1	2	7	6	5	5			1					1		37
Sumana-I		6	6	1	2	10	9	8	7		1		1	1					52
India		4	3	1	1	5	5	4	4	1			1				1		30
Madan Mohan-II		5	4	1	1	8	7	5	5	1			1				1		39
Total		46	40	11	13	68	62	52	47	4	2	4	4	2	2	2	3	2	364
		86		24		130		99											

Source: Field Survey, 2015-16

Table-1.7: Age and Sex Wise Profile of the Workers

Age (Years)	Male		Female		Total	
	No	%	No	%	No	%
0-6	9	2.47	5	1.37	14	3.85
7-14	24	6.59	14	3.85	38	10.44
15-29	42	11.54	18	4.95	60	16.48
30-44	68	18.68	72	19.78	140	38.46
45-59	52	14.29	48	13.19	100	27.47
60-65	5	1.37	7	1.92	12	3.3
Total	200	54.95	164	45.05	364	100
Mean Age	33.74		37.64		35.69	
SD Age	15.84		14.79		15.32	

Source: Field Survey, 2015-16

For determining the depth of water table in the ttudy area, 6 sites (5 from the kiln sites and 1 site from adjacent mouza Deocharai) have been chosen. Deocharai has been selected because during the field survey the researcher observed that the huge amount of top soil has been quarried from this mouza. The depth of water table is measured either from the well or from the tube well during summer (pre-monsoon) and winter (post monsoon) period. The location of the points has been recorded by GPS (Garmin Oregon-eTrex-550).

Table-1.8: Sample Location of Depth of Water Table

SL No	Name of the Mouza	Latitude	Longitude	Depth of Water Table (mbgl)		
				Summer	Winter	Fluctuation
1	Deocharai	26.257 N	89.644 E	3.55	.68	2.87
2	Ghogarkuthi-I	26.456 N	89.022 E	4.30	1.30	3.00
3	Velakopa-II	26.312 N	89.515 E	4.00	1.82	2.18
4	Maradanga	26.311 N	89.567 E	4.10	1.45	2.64
5	Chilakhana	26.316 N	69.600 E	4.15	1.77	2.38
6	Soladanga-II	26.294 N	89.647 E	4.22	1.85	2.37
7	Shikarpur	26.304 N	89.643 E	3.85	1.54	2.31

Source: Field Survey, 2015-16

For determining the soil texture, 4 samples have been collected from Velakopa-II, Maradanga, Soladanga-II and Ghogarkuthi-I. The collected samples were analyzed at the Soil Testing Laboratory, Koch Bihar. The result of Soil texture is tabulated below.

Table-1.9: Sample of Soil Texture

Name of the Mouza	Sand (%)	Silt (%)	Clay (%)	Total	USDA Classification
Velakopa-II	20.93	39.40	39.67	100	Clay Loam
Maradanga	23.82	31.9	48.28	100	Clay Loam
Soladanga-II	25.50	36.90	37.60	100	Clay Loam
Ghogarkuthi-I	28.30	32.50	39.20	100	Clay Loam

Source: Field Survey, 2015-16

To assess the effects of brick kiln industry on nearby agricultural field, soil samples were collected from affected areas of different mouzas. Total 33 samples were collected from quarried, un-quarried and adjacent quarried land of the study area. The samples were collected from 8 mouzas namely 1. Maradanga, 2. Soladanga-II, 3. Velakopa-II, 4. Ghogarkuthi-I, 5. Ghogarkuthi-II, 6. Chilakhana, 7. Shikarpur and 8. Andaran fulbari-II. The quarried, un-quarried and adjacent quarried soils were tested for pH, Organic Carbon, Electric Conductivity (EC), P_2O_5 and Potassium

The soil samples were collected by using a spade; a ditch has been dug to a depth of 6-9 inches setting the soil aside. Then a thin slice of soil was taken from the face to face hole. From the centre of this slice, a 1-inch-wide sub-sample (squared core) is cut from top to bottom. The sub-sample is placed in clean plastic bucket. The procedure was repeated 10-15 locations within the sampled area, retained all sub-samples together in the container. The soil was evenly divided into 4 squares. Then again two opposite sides were rejected and the other two sides have been mixed up. The process is repeated till left with about half kg of the soil.

For determining water quality in the study area 6 sample sites have been selected on the basis of purposive random sampling. Out of six points, 3 (K1, K2 and K3) were chosen

within the kilns and 3 points (O1, O2 and O3) were selected outside of the kiln area from the adjacent mouzas. The location of sample sites is tabulated in the following way:

Table No-1.10. Location of Sample Sites for Water Quality Measurement

Name of the Site	Name of the Mouza	Latitude	Longitude	Nearest distance from kiln	Nature of water body
K1	Maradanga	26˚18′47″N	89˚34′ 07″E	.15 km	Natural: Oxbow lake
K2	Maradanga	26˚18′35″N	89˚34′ 06″E	.05km	Artificial: Burrow Pit
K3	Ghogarkuthi-I	26˚18′29″N	89˚36′ 19″E	.015km	Artificial: Burrow Pit
O1	Bhelakopa-I	26˚17′45″N	89˚34′ 33″E	.95km	Natural: Oxbow lake
O2	Deocharai	26˚16′27″N	89˚36′ 50″E	3.6km	Artificial: Burrow Pit
O3	Ghogarkuthi-I	26˚18′16″N	89˚37′ 42″E	1.6km	Natural: Oxbow lake

Source: Field Survey, 2015-2016

The distance of kiln sites was .015 to .15km from the nearest kiln and the distance of outside points were .95 km to 3.6km from the nearest kiln. The sample sites have been selected either from natural oxbow lake (K1, O1 and O3) or from artificial burrow pit or pond (K2, K3 and O2) in different mouzas such as Maradanga (2), Ghogarkuthi-I (2), Bhelakopa-I(1) and Deocharai (1). The water samples were collected following the method of APHA (2005) during pre-monsoon (April, 2016) and post-monsoon (October, 2015). The pH, Electrical Conductivity(EC), Total Dissolved Solids (TDS) Water Temperature (WT) and Air temperature (AT) were measured readily at the sample sites by HM Digital pH meter (Model pH-80) , HM Digital EC meter (Model-AP-I) and HM Digital Aqua Pro TDS meter (Model-AP-I). The Total Alkalinity (TA), Carbonate (CO_3^{2-}), Bicarbonate (HCO_3^-) and Chloride (Cl^-) were measured by using titrimetric method. Total Hardness (TH) was estimated by ethylenediaminetetraacetic acid (ETDA) method. The free CO_2 is determined by titrimetric method with phenolphthalein as indicator at pH 8.3. Dissolved Oxygen (DO) was estimated by Azida modification method as described by APHA (2005). The Result of the chemical analysis of the water samples have been analysed and discussed.

To determine the water logging problem in the study area, two types of mapping are prepared on the basis of permanent and temporary water logging area. For determining the permanent water logging area, the researcher has used Resourcesat-2 LISS-III image with field verification in those mouzas where brick kilns are located. Modified Normalised

Difference Water Index (MNDWI) is used to extract the pearmanet waterlogged area and used to identify the change detection of permanent water looging area.

$$MNDWI=\frac{Green-SWIR}{Green+SWIR}$$ where in Resourcesat-2 Green band is defined by B-2 and SWIR is defined by B-5. Like NDWI its value also ranges between +1 to -1 where negative values show built up area and positive value show water bodies. For determining the temporary water logging area, a GPS survey was done by Oregon eTrex-550 in the study area. The researcher has identified 90 points as temporary water logging areas from where the soil has been quarried in the previous year i.e. during the period 2015-2016. The points are located in and adjacent mouzas of kiln area. Finally, maps have been prepared by Arc GIS v-9.3.

The main constraint of the study is to monitor the emission factor due to the lack of stack monitoring system. But it is established fact that brick kiln industry produces a large quantity of emission of different types. So, the researcher estimated pollution factor with the help of indirect method. For this the researcher followed different literature to estimate the pollutants created by brick kilns in the study area. As the researcher discussed in previous chapters that total unit of brick production and total amount of consumption of coal and fuel wood, the researcher has attempted to estimate the pollutants such as CO_2, SPM, PM_{10}, PM $_{2.5,}$ CO, SO_X, NO_X for coal combustion and CO_2, SPM, CO, HC, and PAH's for wood combustion.

For calculation of CO_2 emission, the researcher used Dulong's formula which is explained as below:

Btu per pound = 14544C + 62028 (H-0/8) + 4050S

Where, C= Carbon, H= Hydrogen, O= Oxygen, S= Sulphur (Bebcock and Wilcox. Co. 2015)

The estimated Carbon di-Oxide emission is calculated by the following formula-

Carbon% / Btu per pound x 36670= pounds (lbs) of CO_2 per million Btu.

Table-1.11: Specification of Assam Coal

Proximate Analysis		Ultimate Analysis	
Moisture	2.3-2.5	Carbon	68.30-71.3
Ash	11.3-13.50	Hydrogen	4.90-4.91
Volatile Matter	38.0-40.10	Nitrogen	1.50-1.80
Fixed Carbon	43.9-48.40	Sulphur	2.3-5.7
		Oxygen	16.3-23.0

Source: North Eastern Coal Field (2016)

The estimation of World Bank (2007) for SPM is 291.33g per brick of 4.6 kg weight, for PM_{10}. Gains (2010) estimated 8.97gm per brick and Le and Oanh estimated 0.64-1.4 gm of $PM_{2.5}$ per brick is used. For measurement of SO_X, NO_X and CO EIIP (2001) estimation has been followed.

For wood combustion estimation of EPA (1984) and Larsen's estimation (1993) have been used. For 1kg of combustion of wood generates 130gm CO, 51g Hydrocarbon (HC), 21g Particulate Matter (pm), 0.3g Poly-Aromatic Hydrocarbons (PAH's).

1.10. Literature Review:

Research on brick kilns is not scanty. Consequently, there is no dearth of related literature in the field and its allied areas. This literature abounds in short articles. Major works are not adequate the field. The types of literature are many and varied. Some works deal with the technologies and economic aspects of brick kilns, while others deal with only the problems of the labour, impact of brick kilns on environment etc. A search in the field of literature for the proposed work unearthed the following works.

Aggarwal (1959) in his study on the "Socio-Economic Conditions of Brick kiln workers in the Ghazipur village near Lucknow" observed that most of the moulders and carriers of bricks were either semi-skilled or unskilled. The owner of the kilns recruited the labourers through Sardars or labour contractors who convince the labourers to work in the kilns. He also observed that most of the workers belong to the lower caste Hindu family. There was no evidence of any worker who belongs to the higher caste rather considerable numbers of the kiln owner were higher castes of Hindu Community. The workers of the kilns had suffered from dust and unhygienic working conditions, very high range of temperature during summer and winter. The owners of the kilns were afforded a single room which was either made by broken bricks of by thachet. He tried to explore the problems of the workers as well as their low living standard but fails to throw light to mitigate the problems.

Aslam (1993) in his discussion on "Environmental Concerns in Brick Industry" made a comparative analysis on the environmental issues faced by brick kiln industry. He suggested for conserving the environment by adopting fuel-efficient technologies for burning of bricks. He also suggested for accepting the alternate fuel such as Gas or Oil instead of burning of coal. The degraded land should be regenerated with proper reclamation processes he suggested.

Asokan et.al. (2007) in their study "Solid wastes generation in India and their recycling potential in building materials" highlighted that about 960 million tonnes of solid wastes generated in India of which about 350 million tonnes were organic wastes from agricultural sources; about 290 million tonnes were inorganic wastes from industrial and mining sectors and about 4.5 million tonnes were hazardous in nature. They tried to estimate elaborately the various sources of solid wastes generated in India. They not only highlighted the sources of origin but also discussed the challenges and potentials for recycling and utilization of solid wastes. They suggested for generating eco-friendly, energy efficient and cost-effective alternative materials should be initiated to cater the needs in rural and urban areas.

Bhalla (1984) in his edited volume of "Small Scale Brick Making (Tech. No. 6)" attempted to explore the detailed procedure and technology of brick making He prepared this report for ILO and UNIDO. The book contained 10 chapters in which he described a type of raw materials, quarrying processes, pre-processing, drying, firing and organizational pattern for brick manufacturing.

Chopra (1982) in his article "Bondage in a Green Revolution Area: A Study of Muzaffarnagar Brick-Kiln Workers" studied that labour bondage starts in the source region of the labours as they have been paid to advance by the labour contractor for working in the kilns. The workers have been taken advance to meet their basic needs and, thus, compelled to work in the kilns of Muzaffarnagar of UP. According to him, most of the workers belong to Scheduled castes and of who about 75% were illiterate and bonded.

Damile, (1996) in his Newsletter entitled "On the Indian Brick Industry - On the Threshold Mechanization of Brick Industry" described that clay bricks are the main building materials in India. The brick burning processes in India has followed mostly traditional or less efficient method which causes serious environmental problems. The workers of brick kiln sector are the worst sufferers. He propounded that technological transfer from traditional to Bulls Trench Kiln will reduce the environmental emissions. Moreover, he stressed to use

of fly ash instead of topsoil. He also recommended to the kiln owners to introduce the wire cut machinery for better production. But he fails to mention anything about the higher production cost of the industry.

Deliege (1989) in his study "Job mobility among the Brick Makers of South India" highlighted the job mobility among the brick kiln workers in Pariyar village of Ramnanad district of Tamilnadu. He studied that the traditional as well as brick making work of the village. The owners of the kilns bought clay from the outside of the village and carried by bullock card to the kiln. He also described various works performed by the workers in kilns. He mentioned the modern works like printing shops, cycle shops, restaurants, spinning mill etc. in his study. He noticed that the occupation of the village workers has changed significantly during the last 20 years. He concluded in his study that the shifting of the job from traditional to brick makers to the modern job makes the villagers switch from misery to poverty.

Dey and Dey (2015) in their article ""Deterioration and Degradation of Aquatic Systems Due to Brick Kiln Industries – A Study in Cachar District, Assam." highlighted the impact of brick kilns in water bodies of Cachar district Assam. The study focussed on the chemical change of water in and around brick kilns and their impact on the hydro Geochemical as well as biological lives.

Dharmalingam (1995) in his article "Conditions of Brick Workers in South Indian Village" discussed the condition of the brick workers in some villages of Tamilnadu. He divided all the workers in brick kiln industry as main workers and co-workers whose demographic as well as wages and debt were discussed in detail. He also highlighted about the occupational health hazards and loss of labour days of the workers. If the natural calamity such as rain destroys the raw bricks the wage of the workers are not paid. He tried to explore the changing nature of the society from agrarian to industrial workers and its impact on the social life of the villagers.

Ercelawn and Nauman (2004) in their article "Unfree Labour in South Asia: Debt Bondage at Brick Kilns in Pakistan" an attempt has been made to show the conditions of brick kilns in Pakistan in terms of low wages, debts, and poor and insecure shelter of the workers. The article has been divided into three Sections-Sec-I is about an introduction, Sec-II discusses production process, jobs, and earnings and in Sec-III they highlighted about the

conditions of forced labour, debt, and bondage. In conclusion, the authors discussed the directions for relief and remedy of the brick kiln workers.

Gazette, MoE (1999) notified that if someone wishes to establish brick kilns within the radius of 50 km of power plant they bound to use 25% ashes for brick making. The Ministry of Environment directed to all State Government Pollution Control Board to monitor the order.

Ghose (2009) in his lecture on the title "Fragmented Labour and Elusive Solidarity: The Brickfields of Bengal" tried to focus the problems of the brick kiln industry in West Bengal. The major problems are the scarcity of raw material and coal, Government royalties and tax, legal complications and environmental clearance etc.

Ghoshal (2008) in his book titled "Prospects and problems of Brick Industry" made an effort to study different economic and non- economic aspects of the brick industry. He discussed organizational and administrative setup, marketing and manufacturing techniques of brick industry. He also discussed financial analysis including ratio analysis, break-even analysis, demand, and supply analysis and major constraints of this industry.

Gulati (1979) in her paper "Female Labour in the Unorganized Sector: Profile of a Brick Worker'' mentioned that the task performed by the workers in brick kiln industry is based on sex. She tries to explore the status of women in the labour force in brick kiln industry in southern India. She has also put evidence in the unorganized nature of brick kiln industry. To her, women have generally performed carrying of green bricks on head load to the dock and also carry fired bricks to the stackyard. The male members of the workers have performed various works such as clay preparation, kneading, moulding burning of bricks etc. As the consequence women have been paid lower wages than men. Thus, there is prevailed division of works and discrimination of gender vis-à-vis Sex.

Gupta (2003) in her article "Informal Labour in Brickkiln: Need for Regulation" studied 51 brick kilns in the regions of Haryana, Ghaziabad, and Uttar Pradesh. She identified that about 60.8% workers were landless and 37.3% were marginal farmers. The workers were recruited through 'Jamadars' of labour contractors accompanied by the advance system. She identified that the various laws such as Labour Laws, Abolition of Bonded Labour Act etc. have been violated in most of the kilns. On the discussion elaborately the author feels to initiate new regulations for the brick kiln workers.

Gupta and Mistry, (1993) in their annual newsletter "Conservation of Clay and Coal in Brick Making" show that brick kiln industries are the major contributor to the topsoil degradation in Tamilnadu where about 2000 kilns were operating. As good quality topsoil is the main raw material for making the bricks, the areas with brick kiln clusters hamper the other economy such as agriculture, forestry, and agroforestry. So the authors suggested replacing the fertile topsoil as raw material by fly ash, agricultural and industrial wastes, red mud etc.

Iqbal (2006) in his article "Bonded Labour in the Brick Kiln Industry of Pakistan" attempted to highlight the poverty and debt bondage are closely associated in the brick kiln industry in Pakistan. He has attempted to explore the nature and extent the bad effect of debt bondage among the children as well as women workers. Indebtedness of the labours has been treated as the vicious circle and it continued through the ancestor. Over time works and unhealthy working conditions of the workers made them retard the mental, psychological, and physical growth of the children. The author has directed to some measures to eradicate the bonded labour in brick manufacturing industries in Pakistan.

Jones (1996) in his book "The Basics of Brick kiln technology" described a detailed study on the history of brick making and basic processes of drying and firing of brick. He classified brick kiln technology as Up- Draught kiln (Clamp kiln, Scove kiln, Scotch kiln), Down- Draught Kiln, Horizontal Draught Kiln, Continuous Kiln (Hoffmann Kiln, Bull's Trench Kiln, Inverse arch Kiln, Vertical shaft brick Kiln). He tried to give a vivid picture of advantages and disadvantages of each type of kiln.

Khan and Rasulan (2000) in their article "Assessment of Environmental impacts and Socio-economic Factors of Brick Kilns in Peshawar, Pakistan" tried to establish the impact of brick kilns and Socio-economic impact of brick kilns in Peshawar. The workers of the kilns exposed to black smoke and dust. They found that about 45% workers were suffering from respiratory problems. They also indicated that 15% and 10% workers suffered from eye and skin diseases.

Khan, et.al. (2007) in their article "Assessment of degradation of agricultural soils arising from brick burning in selected soil profiles" discussed about the effect of brick kilns on burnt (around the kilns) and unburnt (adjacent to kilns i.e. agricultural field) sion in Dinajpur, Rangpur, Rajshahi, Khulna, Pataukhali districts of Bangladesh. They have identified the different soil profiles and estimated soil pH, EC, Organic Carbon, organic

Matter, Nitrogen, potassium and phosphorous in the soil. They identified a significant change of chemical properties of the soil. They identified a change of 7% negative change of pH, EC value rises to 592%, Organic matter (-63%), N(-56%) , P(-86%), K(-23%) and Sulphur (-88%). They also identified that due to the loss of nutrients in the soil, the fertility of the sol and production of crops decreased significantly.

Kumar and Sidhu (1995) in their article entitled "Pull and Push Factors in Labour Migration: A Study of Brick Kiln Workers in Punjab" an attempt had been made to recognize the push and pull factors that lead to the workers to migrate towards the kiln. The main pull factors for migration of the workers, the authors identified as industrial advancement, better job opportunities with higher wages in Punjab. In their study, the authors try to establish the fact that economic factors play a vital role in the processes of migration. They recommended that there should be initiated proper regulation of migration processes as the urban industrial sector has limited absorption capacity for the workers. Further, they suggested minimizing the differences of economic development in the urban and rural areas.

Lakshmikanthan (1999), in his article "Vertical Shaft Brick Kiln Technology in India" highlighted the relevance of VSBK technology in India as to him this is the best method of the firing of green brick in terms of environmental perspective. He mentioned that though the VSBK technology was invented in China, it may be useful to Indian perspective as it is energy efficient, eco-friendly and produce good quality of bricks.

Lauri, (2017) in his article entitled "The Absence of Freedom: Debt, Bondage, and Desire among Pakistani Brick Kiln Workers" discussed the 'slavery-like forms of labour exploitation' in Central and South Asia. His study was based on the debt bondage and absence of freedom among the labourers of brick kilns in Pakistan. He has thrown light on the different types of works performed by the workers and genesis, nature and extent of debt bondage in Pakistan. He observed that peshgi or advance system and debt bondage are very much interrelated. He mentioned that capitalism was established in the colonial Indian subcontinent and this tradition continues and is reflected on the debt bondage system in Pakistan. Thus, the author opined that indebtedness among the workers makes the workers vulnerable to social marginalization and legal and economic uncertainty.

Le and Oanh (2010) in their article "Integrated assessment of brick kiln emission impacts on air quality," estimated the emissivity of CO, SO2, PM, and CO2 by coal combustion in brick kiln industry. They have monitored 6 brick kilns at Bac Nih province of

North Vietnam. They used dispersion modeling to monitor the environmental quality. They identified 8.53± 3.0-ton coal is required for burning of 1000 bricks.

Maithel (2013) in his report “Evaluating Energy Conservation Potential of Brick Production in India” highlighted the historical background of brick making, regional differences of brick manufacturing, the technology of firing of bricks, environmental and social impact of brick kiln industry. He also made a comparative analysis of FCBTK, High Draught kiln, NDZZK and VSBK brick kilns in term of energy, economic, social performance. A brief description of National Coal Policy and environmental policy are also mentioned by the author.

Majumdar, et.al. (1969) in their study "Survey of the Thermal efficiency of Bull's Trench Kiln" have revealed that the thermal efficiency of Bull’s Trench Kiln ranges from 18-23%. They have also studied that for burning of green bricks by Clamp kiln and Down Draught kiln requires 40-50 ton of Grade-I Coal whereas Bull’s Trench kiln consume 20 tons of coal for burning of one lakh bricks. Moreover, the thermal efficiency depends on the type of clay used for making bricks they explored.

Miraj, et.al. (2017) in their article “Observation on the TDS and EC Values of Different Water Bodies at Cooch Behar, West Bengal, India” tries to correlate TDS and EC on selected water bodies in Koch Bihar. They have collected water samples from 9 natural oxbow lakes and 4 man-made ponds and analyzed data to establish the relation. They also highlighted the impact of TDS and the EC in aquatic life.

Molankal (2011) in his book “Bricks of Burden: Women in Brick Kiln Industry in Barak valley, Assam” has described the Socio-Economic profile and Working conditions of the women in brick kiln industry in Barak Valley, Assam. He has also tried to explore the health status of the women and the work as the burden to the women in brick kiln industry. He discussed in elaborate with taking some case studies the agony and sufferings of the women workers. To him, the female members of the working group have performed triple actions such as burden of work, home, and childcare. He suggested in his book to ensure basic civil and political right of women under burden as well as to intervene the government for the betterment of women workers in the study area.

Pandey (1985) in his study “Employment Potential of Brick Kiln” revealed that brick industry created employment opportunities for 120 to 150 days in 2 years. The total capital

outlay per kiln was Rs.6.74 Lakhs. This study identified that 46 percent of the total expenditure was incurred on fuel alone. So he suggested various measures to control fuel cost. He suggested that whiteware items and terra-cotta products have good export potential if quality goods are produced.

Pandey et. al. (1969) in their study "Employment Potential of Brick Kiln" has tried to analyze the employment potentiality in and around Delhi and Karnal. For this purpose, they had taken five brick kilns as the sample. To them, the brick kiln industry creates seasonal job opportunity to the rural poor who were engaged either as the cultivator or as agricultural labourers. They identified that the living and working conditions of the workers were worst and made suggestions to mitigate the problem. The main findings of the study were the problem of capital investment of the owner as well as the problem of expenditure for fuel and labour costs.

Pangtey, et.al.(2004) in their article “An environmental profile of brick kilns in Lucknow” studied 22 brick kilns to explore the environmental impact of brick kilns in and around Lucknow. They tried to quantify the environmental degradation caused by brick kiln industry. In their study, it was observed that 18.18% of the kilns were Moving Chimney Bull’s Trench (MCBTK) type and the height of Chimney was also less than the prescribed height as stipulated by the CPCB. About 1.89 acres of land on an average were degraded by each kiln which was the main cause of the nutrient deficiency for plants around the kiln sites.

Patil, et. al. (2017) in their article “A Cross-Sectional Study of Socio-Demographic and Morbidity Profile of Brick Kiln Workers in Rural Area of Karad, in Satara District” studied about the socio-demographic factors, morbidity profile, living and working conditions of the brick kiln workers. For this purpose, they surveyed 51 males and 29 female workers from 8 villages of Karad taluka, Satara district of Maharashtra. The study revealed that 71.25% brick kiln workers were illiterate whereas in the control site only 3.75% persons were workers. They tried to show that about 10-43% workers were suffering from the various musculoskeletal disorder, respiratory illness, and digestive disorder. But in the control sites, the health problems were not severed or acute. They commented that the socioeconomic status of the workers was very low and morbidity pattern was high.

Rozenmuller (1999) prepared a report for UNDP on the title “An Overview of Bricks and Tiles manufacturing industries in Northwest Cambodia” for discussing the present situation of the bricks and tile manufacturing industries in Cambodia. He presented a brief

description of the brick and tile industry in Cambodia and manufacturing process. He identified 317 brick kiln units in Cambodia and four types of kilns such as the square kiln, round kiln, elephant kiln and boat kiln. He has taken 14 kilns of North West Cambodia as for case study. He then discussed in detail about the total production of bricks and roofing tiles, Cost structure, Fuel and clay usage, number of workers etc. He recommended for improving the efficiency of kilns and for setting up the 'National Brick Manufacturers Association' throughout the Asia.

Sahu, et.al.(2010) in their article "An Ergonomic Study on Teenage Girls Working in the Manual Brick Manufacturing Units in the Unorganized Sectors in West Bengal, India" an study was carried out in four brick kilns to reveal the ergonomics of teenage girls who were engaged in manual brick manufacturing units of West Bengal. The teenage girls carry baked and unbaked bricks of about 49.11 kg on their head load. The study revealed that 86% of such girl suffered from work-related pain. The authors have analyzed BMI, body weight, Physiological, psychological, MSDs, awkward postures while at work (OWAS) of the girl workers. They have suggested some alternative methods to reduce the MSDS and other health-related problems.

Saran and Sandhwar (1990) in their book 'Problems of Women Workers in Unorganized Sector' have described to identify and understand the problems of women working conditions in Brick Kilns, Quarries and Mines of Bihar and West Bengal. The book gives much information about Socioeconomic and Physical exploitation of women workers. According to them most of the migrant labourers in the brick industry are treated as bonded labourers. The owners of the kilns imposed restrictions to the workers not to communicate the workers with their family members and they are not to allow for leaving the kiln site during the working season. The basic right such as maternity leave of the female workers is not given to them. They have not been provided the medical allowances for their common ailments. There was no provision to compensate the injured workers who have been departed from their work.

Singh (2005) in his paper titled "Women Workers in the Brick Kiln Industry in Haryana, India", stated that women workers mainly work in the semi-skilled jobs as helpers in moulding, in carrying and unloading operations. In moulding operations, the women workers make a dough of mud and bypass to their male partners. They carry the raw green bricks to the kiln either on their head or horse/ pony driven carts. They also performed as un-

loaders of fired bricks from the dock and carry to the stack yard generally on their head. A similar study was carried out by the author on the title “Living Conditions of Women in Brick Kiln Industry of India: Reflecting the agenda for social work intervention” and presented in a seminar held at Nagasaki International University, Japan in July 2003. For this study, he had chosen randomly 54 kilns out of 547 kilns in the Hissar district of Haryana. In both papers the author has made some suggestions to the owner of the kilns for providing healthy environment, safety and welfare measures to the women workers.

Sinha, (1994) in her study on “Conditions of Women Workers in Brick Kilns” at Alipore region near Kolkata discussed the conditions of women workers in brick kiln industry. To her, most of the kiln owners appointed labourers through intermediaries. Women are the worst sufferer as they provide best services to the kiln but they are exploited in terms of wages and tortured even sexually and physically. She in her article tried to explore the recruitment procedure, working conditions, wage structures and other welfare measures for the workers. She mentioned all the basic amenities which are lacking in the kiln sites but she fails to suggest how to overcome or how to provide such facilities to the workers.

Upadhya (1991) in his study “A Socio-Economic Survey of Immigrant Labour in Brick Making Industry in the Sangli District, Maharastra’’ described the low living standards, poverty, illiteracy and exploitation of migrated labour. He discussed the economic profile of the immigrant labourers in the study area. He further explored the process of brick making, the working conditions of the immigrant labourers and made suggestions to resolve the problem.

Vikrant, et.al. (2016) in their article “Epidemiological Study of Health Hazards & Working Conditions of Brick Kiln Workers in Rural Area of North Maharashtra,” attempted to discuss the health status of brick kiln workers, their working conditions and safety measures in North Maharashtra. For this purpose, the interviewed 86 patients who have engaged themselves as brick kiln workers. The major findings of the article are that about 70% workers received less than Rs.150/-, 14 % of workers were below 14 years and about 83% of workers work 8-9 hours per day. About 58.7 % of the workers suffered from various musculoskeletal disorders (MSDs) and a significant number of workers had suffered from digestive disorders and respiratory problems.

Yousaf, (2011) in his editorial article entitled “Brick kiln industry in Pakistan” highlighted about the movement of brick kiln workers for their basic right. He mentioned that

the production process of brick in Pakistan is still being practiced by traditional to semi-modernized method and side by side the labourers are exploited. He pointed out the miserable conditions of the workers as well as the violation of the basic right of the workers.

The reviews of the above literatures indicate that the all issues relating brick kiln industry is not discussed under an umbrella. Moreover, the present study area was unveiled by any researcher or governmental initiative was negligible for the development of brick kiln industry. The present researcher has tried to explore major issues relating to brick manufacturing.

1.11. Limitations of the Study:

During the course of this study, the researcher faced many problems. These problems have caused some limitations for the study. Some of the limitations are mentioned below:

1. One of the main difficulties of the study is the lack of availability of secondary data about the kilns as well as the workers. The work mainly depends on primary source of data which may not be up to the mark in certain cases.

2. It is troublesome to collect data in detail from illiterate or semi-literate workers. Because they are either afraid of their employer or they are not ready to give detailed information about their wages, working conditions, living conditions, attitude towards employer, Union and sexual harassment.

3. The task of collecting data and to interrogate the labourers was also difficult because the researcher was compelled to explain the purpose of his study to the union leader, brick kiln owner as well. A modest attempt has been made here to throw light on the issues connected with quarrying activity for solving the existing problem.

4. Non- cooperation of the entrepreneurs, improper maintenance of register of workers is the other limitation of the study.

1.12. General Background of the Study Area:

1.12.1. General Description of Koch Bihar:

West Bengal is clearly divided into two parts- North Bengal is bounded by Himalaya in the north and Ganga-Padma in the south, another one i.e. South Bengal is lying to the south of Ganga-Padma stretching up to the sea. North Bengal has seven districts- Darjeeling, Jalpaiguri, Alipurduar, Koch Bihar, North Dinajpur, South Dinajpur and Malda. Among them Koch Bihar, the present area of study has been transformed from an earlier princely state and to the present status of a district. Earlier Koch Bihar was a princely state ruled by the king of Koch dynasty who had been a feudatory ruler under British government. On 20th August, 1949, by an agreement, the king of Koch Bihar ceded full and extensive authority, jurisdiction and power of the state to the Dominion Government of India, while the transfer of administration came into force on 12th September, 1949.Eventually Koch Bihar was transferred and merged with the province of West Bengal on 19th January, 1950 and emerged as a new district in the administrative map of West Bengal. But till now, Koch Bihar remains one of the backward districts in West Bengal.

The name Koch Bihar is compound of two words- 'Koch' and 'Bihar'. The term 'Koch' is a corrupted form of 'Cooch' being the name of a race of people inhabiting a large tract of country in the north-east of Bengal and 'Bihar', derived from *'Vihara'* denotes abode or sport. Taking the first sense of second word, it means land of Koches, while in the second sense, the compound means 'land of sporting with the Koches' (Chowdhury, 1903).

1.12.1.1. Location of Koch Bihar:

Koch Bihar lies between approximately from 25°57′57″ N to 26°32′58″ N and 88°45′28″ E. to 89° 51′50″ E. The Geographical area of the district is 3387 sq km which occupies 128 Gram Panchayet with 1202 Mouzas. Koch Bihar is bounded on the north by Western Duars, which form the eastern part of the district of Jalpaiguri; on the east by Guma Duars, Pargana Ghurla of Assam District of Goalpara and Parganas Gaibari and Bhitarband of Rangpur, Bangladesh; on the south by Chakla Purvabhag and Parganas Kakina and Kazirhat in the district of Rangpur, Bangladesh and Pargana Patgram in the Kazirhat in Jalpaiguri; and in the west by Pargana Kazirhat in Rangpur and Chakla Boda in Jalpaiguri.

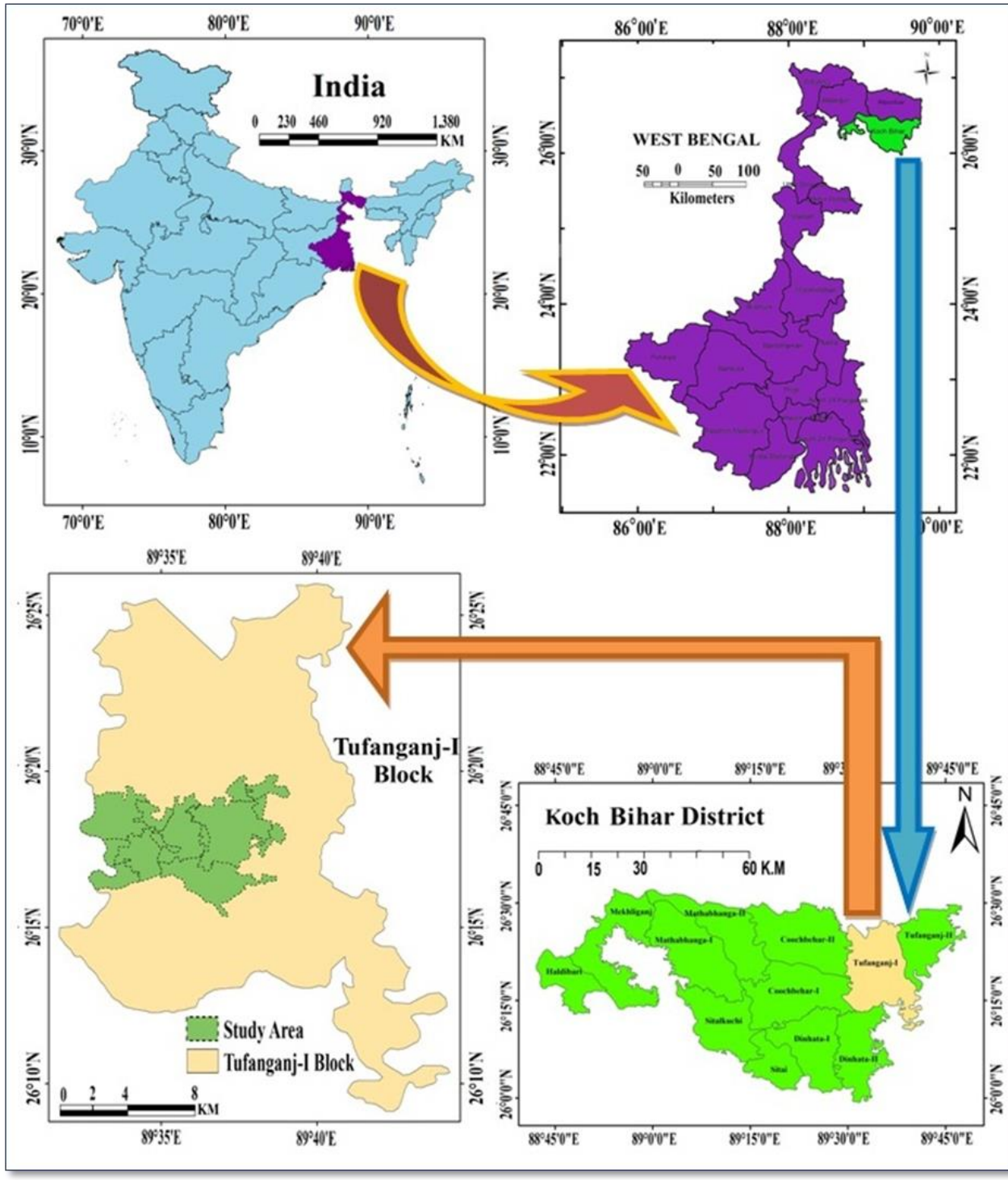
1.12.1.2. Location of Tufanganj Block–I:

Tufanganj–I is one of the 12 community Development Blocks of Koch Bihar district within the Tufanganj subdivision. It lies between the parallels of latitudes of 26° 9′7″ N to 26° 26′ N and meridians of 89° 31′ 44″ E to 89° 44′15″E. The subdivision is bounded in the Northern part by Jalpaiguri District, Western part by Koch Bihar–I block, Eastern by Assam and South and South-East by Bangladesh.

1.12.1.3. Location of the Study Area:

The study area lies between Ghargharia-Kaljani-Gadadhar interfluves. The maximum concentration of brick kiln is found in Tufanganj Block-I only because of availability of particular type of earth *'Atta matti (Clay Loam)*—the basic ingredients of brick. The latitudinal and longitudinal extension of the study area approximately is 26º15′19″ N to 26 º 20′ N and 89º 32′20″ E to 89º 39′8″ E respectively. The present study was conducted in 6 mouzas namely, Maradanga, Soladanga-II, Velakopa-II, Ghogarkuthi-I, Chilakhana and Shikarpur.

Map-1.1. Location of the Study Area

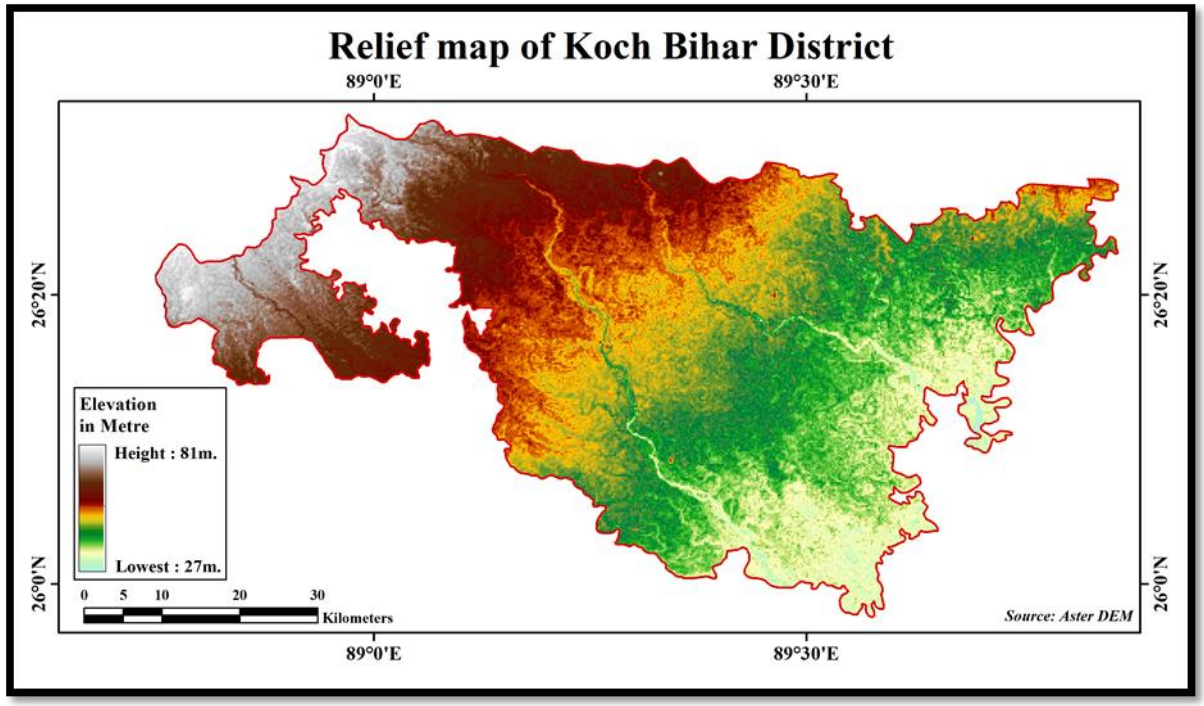


1.12.2. Physical Background:

1.12.2.1. Physiography & Relief:

Physiographically Koch Bihar is situated in the Sub-Himalayan region of West Bengal. This zone comprises the plains districts of Jalpaiguri, Koch Bihar and Siliguri sub-division of Darjeeling district. Koch Bihar basically is a flat country with a gentle slope towards the south-east along which the main rivers of the district flow. A large network of rivers and rivulets traverse the district from north-west to south-east direction creating a number of bills and ox-bow lakes. Being very near to the foothills, the rivers often spill their banks after heavy downpour. Sitalkuchi and Sitai have the relative high altitude whereas most of the lowlands lie in Dinhata region. The average altitude of Koch Bihar is 60 metre (m) from mean sea level. There are neither mountain peaks nor hills; physiographically there is a very little diversity in relief and surface configuration of the district. Extreme horizontality of monotonous gradational plains is its main characteristics. There is large number of marshy land in the district and in many lowlands flood water stays for a long period.

Map-1.2: Relief Map of Koch Bihar District



1.12.2.2. Geology:

Koch Bihar District is underlain by quaternary alluvium which lay down by numbers of rivers. New alluvium formation has been found everywhere but no older alluvium formation has been found anywhere in the Koch Bihar District within the depth of 304 metre below ground level (mbgl). The alluvium deposits are buried by different streams & rivers which are flowing from mountain area. The sediments are composed of boulder, pebble, cobble, sand etc. The medium to large sized boulder, pebbles & gravels are well rounded and organized during Precambrian Daling Quartzites, granite etc. The northern part of West Bengal including Koch Bihar District was largely made up of fluvio-catastrophic deposits of the quaternary period, while most of the southern part consists of Pleistocene to recent flood plain deposit (Mazumdar, 1977).

1.12.2.3. Drainage System:

The river system of Koch Bihar plays a significant role on her relief, soil, agriculture and irrigation. The rivers of the District can be effectively classified into two systems - i) Perennial River ii) Non –Perennial or remnant channel. Nature of these rivers has their origin in the Himalaya and mostly snow fed. The principal rivers of the district begin from the west are the Tista, Dharla, Jaldhaka, Torsa, Kaljani, Raidak or Sankosh and Gadadhar. They all flow from north-west to south-east. They are all running almost parallel to each other and flowing towards Bangladesh. Mostly they are dendritic in pattern. Nature of these Rivers has its origin in the Himalaya and mostly snow fed. The Torsa, the Raidak and the Sankosh have their origin in the glaciers of the Greater Himalaya along the northern border of Bhutan. The streams which are coming from the lesser Himalaya are entirely rain-fed and are generally non –perennial. Huge amount of silt, pebble, boulders are being carried by these rivers. After entering Koch Bihar, the rivers become meandering in nature. The majority of the rivers originates in the Himalayas and enters from a north to north-western direction and flows south to south-easterly direction. The lateral gap between the two major rivers is in between 5 to 30 kilometres i.e., Kaljani - Gadadhar – Raidak and Sankosh respectively. As many of the rivers originate at the same hill, flood often occurs simultaneously in many rivers and the rivers coalesce to form a single vast sheet of water. The rivers of Tufanganj flow in slanting course from northwest to southeast. All of them rise in the Himalayas and enter the subdivision from the western duars of Jalpaiguri district except one which enters from the gamma duars. Flowing through the subdivision they pass on the Rangpur district of

Bangladesh to discharge their water into the Bramhaputra. By the end of October, the water comes down considerably and in March the rivers became almost dry. There are six major river systems drain through the subdivision (Map- 3). A brief account of the important rivers of the district are given below –

Torsa: The Torsa is of the most important rivers of Koch Bihar district and after flowing a long distance it enters at Balrampur of Tufanganj-Block-I after which it merges with the Kaljani River. The tributary of the Torsa is the Ghargharia in the Tufanganj subdivision which comes from north-west side and joins with the river Torsa.

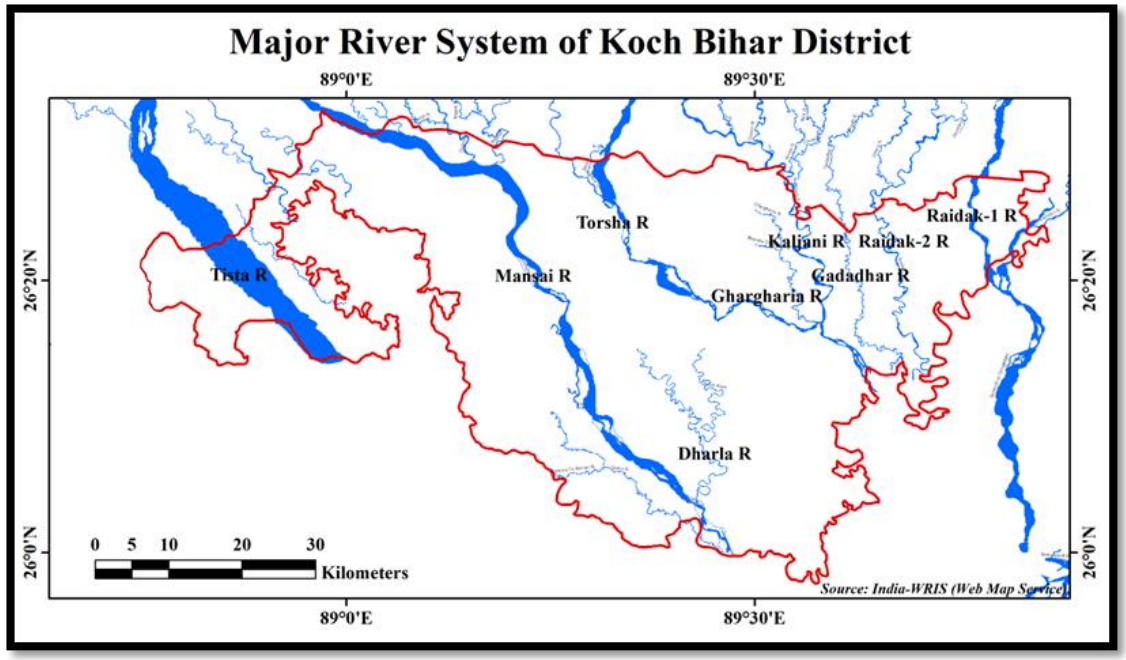
Kaljani: The Kaljani enters the subdivision at Ranisala and after flowing some distance it meets with river Torsa. The combined flow of these two rivers enters in Bangladesh. It is a quick flowing river in the district.

Gadadhar: The Gadadhar River takes its rise in the Bhutan hills east of Buxa, where it is known as the Jainti River. It takes the name of Gadadhar from the junction of the Sachaphu falls into the Kaljani at Chalnipak. The river meets with the Alaikuri on its right bank in at Kaljani Village.

Raidak: The Raidak enters the district from the duars in between the Dorkho and Chengtimari, Raidak has two branches- one is flowing in the eastern part of Tufanganj-II blocks and joins in the Sankosh River and another one is Raidak-II which is flowing through the Tufanganj town and joins with the Kaljani River at Balabhut of Tufanganj-I block.

Sanfola: It is a right bank small tributary of Raidak-II in Tufanganj-I block. It is dry in winter season. During rainy seasons it becomes furious and floods the surrounding area. During the the rainy season, it connects with Gadadhar and meets with Raidak.

Map-1.3: Major River System of Koch Behar District



1.12.2.4. Climate:

1.12.2.4.1. Temperature:

The climate of Koch Bihar District is hot-humid, sub-tropical in nature. The cold season is from mid-November to the end of February. This is followed by hot seasons from March to May. June to August is the season when south-west monsoon arrives in the district and causes heavy rain fall. The summer season is from April to May with April being the hottest month with 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 end of November and lasting until February. In this season mercury rises to maximum of about 24°C with minimum temperature about 10°C. Temperature begins to drop steadily from December and reaches to its lowest between the last week of December and second week of January. The months with mark the state of transition from cold to heat and heat to cold are March and October denoting spring and autumn of Koch Bihar. The weather is very pleasant during this time. Temperature gains continuous increase in the month of April to July.

Table-1.12: Maximum and Minimum Temperature of Koch Bihar District

Month	2001		2002		2003		2004		2005		2006	
Temp ˚ C	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
January	7	27	8	26	5	27	6	26	9	26	9	28
February	8	30	7	30	10	29	6	30	12	31	12	30
March	11	35	12	34	8	33	13	36	15	34	14	35
April	17	36	15	33	18	34	17	34	17	33	17	36
May	19	35	19	35	19	36	19	35	20	35	20	37
June	22	35	21	34	21	36	20	35	23	35	22	35
July	23	36	22	35	23	37	21	34	23	35	24	36
August	23	35	22	35	21	36	22	35	24	35	24	38
September	21	34	22	35	22	34	21	33	24	36	23	35
October	16	36	17	33	19	33	15	33	17	33	17	34
November	9	31	13	32	13	32	10	31	14	31	13	31
December	7	27	9	30	9	27	7	29	10	28	10	28
Average	15.3	33.1	15.6	32.7	15.7	32.8	14.8	32.6	17.3	32.7	17.1	33.6

Contd……

Month	2007		2008		2009		2010		2011		2012		2013	
Temp ˚ C	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
January	5	29	11	28	9	28	7	29	5	27	5	28	4	28
February	10	29	12	32	10	31	7	31	9	32	6	29	8	33
March	11	36	16	35	11	36	14	37	11	35	10	35	14	35
April	17	36	22	37	18	36	18	37	16	35	18	38	15	36
May	21	37	23	38	20	37	21	35	21	36	17	35	20	36
June	22	36	23	36	22	36	23	35	23	37	20	36	23	37
July	24	35	25	38	25	37	25	36	24	35	24	35	24	35
August	24	37	26	37	24	36	25	35	23	36	23	36	24	37
September	21	35	24	36	24	36	23	35	24	37	22	37	22	36
October	18	35	18	35	18	35	19	35	17	35	15	33	18	34
November	12	32	14	31	11	32	12	32	13	31	11	31	10	32
December	8	29	9	26	7	29	8	33	7	31	6	28	7	31
Average	16.1	33.8	18.6	34.1	16.6	34.1	16.8	34.2	16.1	33.9	14.8	33.4	15.8	34.2

Source: IMD, Kolkata

Table-1.12: Average Maximum, Minimum Temperature and Rainfall of Koch Bihar in Different Years

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	27.0

Source: IMD, Kolkata

Fig-1.1: Variation of Temperature and Rainfall in Koch Bihar

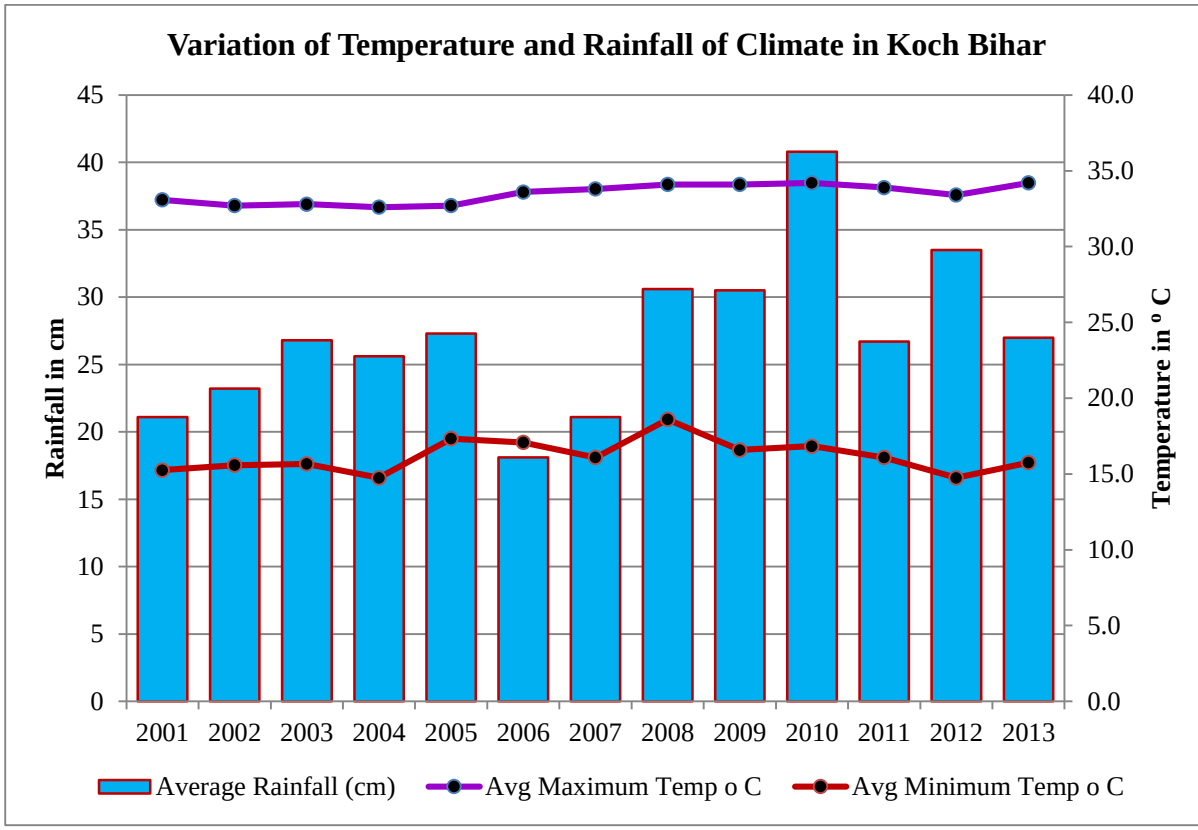


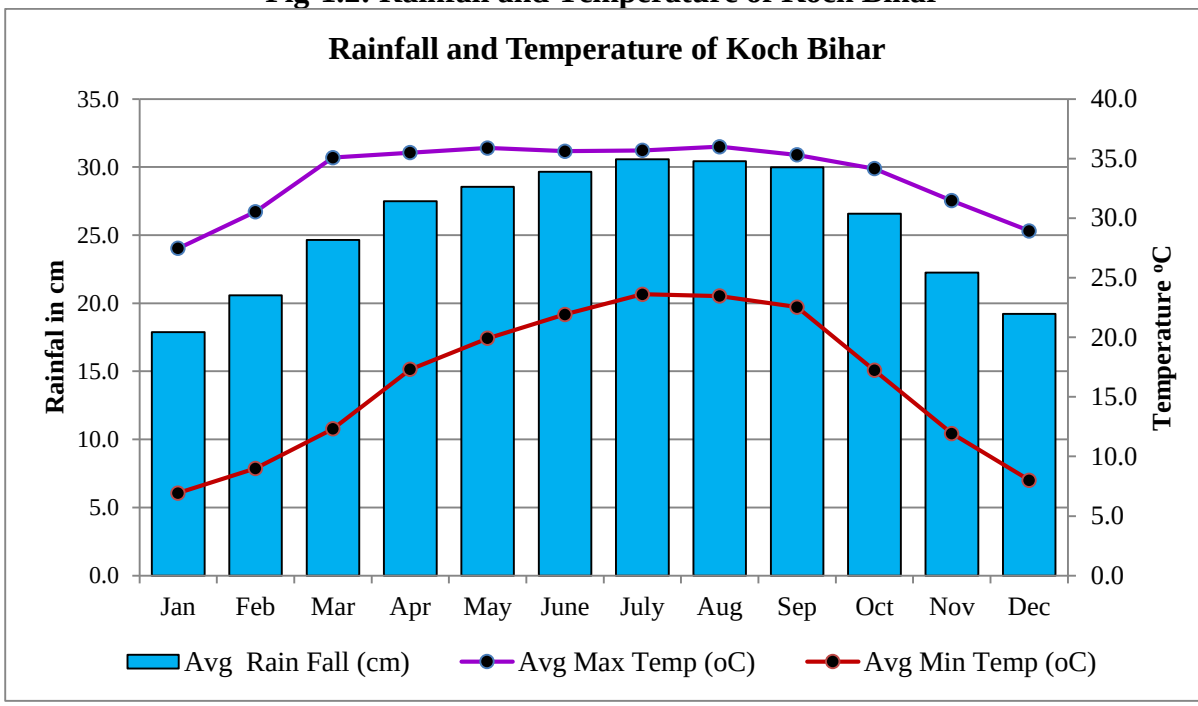
Table-1.10 Shows the mean daily maximum and minimum temperature in ºC from 2001 to 2013. The highest temperature was recorded is 38ºC in the month of April in 2010. The maximum temperature may sometimes go up to >35ºC. The fig-1.1 depicts that the mean maximum temperature was highest in the year of 2010 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 the variation in the mean maximum temperature of the study area.

Table-1.13: Average Maximum, Minimum Temperature and Rainfall of Koch Bihar

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Avg. Max Temp (° C)	27.2	30.3	34.8	35.1	35.5	35.4	35.3	35.6	35.1	33.9	31.2	28.8
Avg. Min Temp (° C)	6.9	9.0	12.3	17.3	19.9	22.1	23.8	23.5	22.6	17.5	12.1	8.2
Avg. Rain Fall (cm)	1.1	1.4	4.4	17.5	30.1	59.4	68.8	42.6	41.6	19.1	0.4	0.5

Source: IMD, Kolkata

Fig-1.2: Rainfall and Temperature of Koch Bihar



The Fig-1.2 Shows that January is the coldest month in the short winter season where lowest temp was recorded. (6.9˚C). The mean minimum temperature was recorded in January (6.9ºC) 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 (36.0˚ C). It is also observed that the mean maximum temperature was consistently high during the summer season.

1.12.2.4.2. Rainfall:

As the climate of Koch Bihar is sub-tropical monsoon in nature, the region witness heavy shower during the summer. The winter is generally dry but it witnesses light shower due to western disturbances. The region also frequently witnesses by *'Kalbaishakhi'* during the month of March-April. It causes havoc to the *Zaid* crop and tobacco cultivation. The *kalbaishakhi* is very much harmful to the production of bricks also. It is evidenced from the table-1.13 and 1.12 that most of the rainfall occurs during the summer season. About 88.62% rainfall occurs during the months of May to September. This huge amount of rainfall causes a recurrent flooding problem 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-1.14: Rainfall 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

1.12.2.5. Soil:

Soil of the study area is alluvial in nature. Most of the areas of the district are covered with fertile alluvial soil. But in many tracts of the district especially where bank erosion is dominant, sandy soil is found. The soil of the district is alluvial of recent formation and has an admixture of sand which is known as sandy-loam. The properties of sand silt and clay however varies from place to place. The soil is of light texture and can retain moisture. The surface soil is sandy. The depth of soil in the district varies from 1000m-1500m and forms with sand and alluvial which has been carried by the rivers from Himalaya. Nature of soil is light and percentage of sand is high. So, it cannot store water sufficiently for the normal growth of most of the common species of plants. pH value of the soil varies from 4.5-6.5. There are mainly five types of soils found in the district, namely:

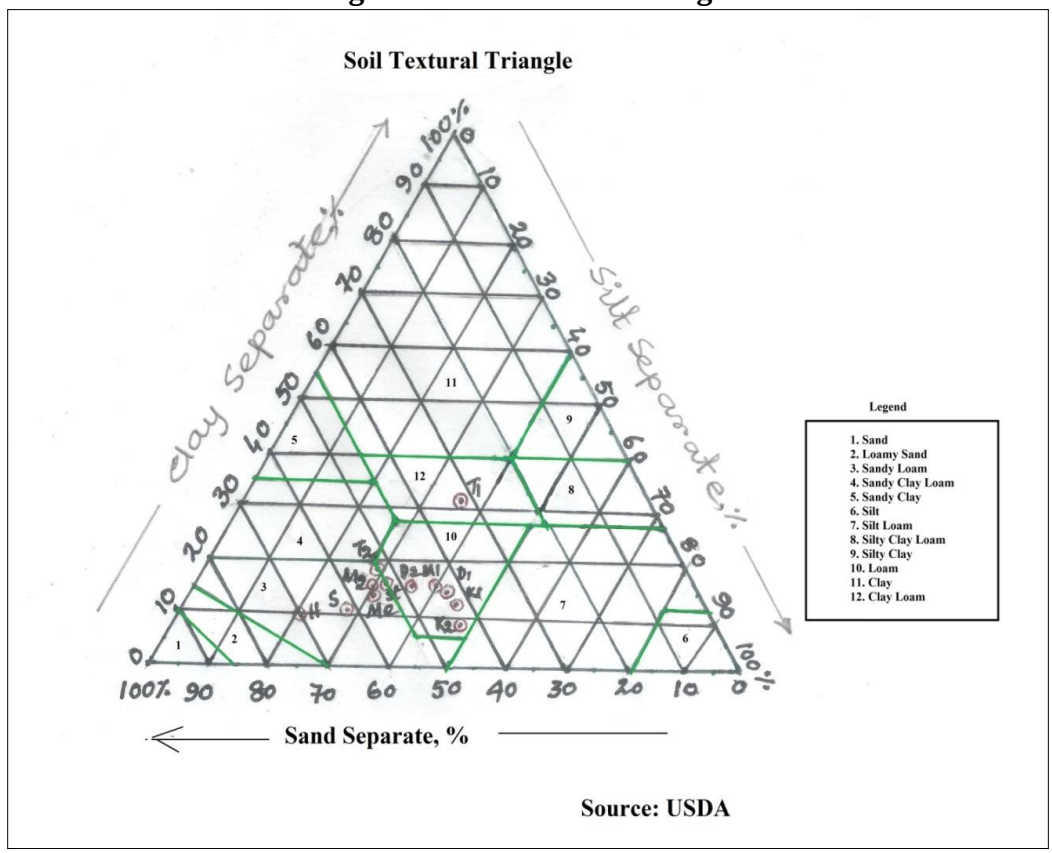
1. Silty-loam soil
2. Sandy-loam soil
3. Sandy soil
4. Newer alluvium soil
5. Older alluvium soil

The soil in the most of the part of the district is of ash coloured. Clay loam is also found in eastern part of the district bordering the Goalpara district of Assam to the east of the

Kaljani River. Some Clay loam is also found in the region between Jaldhaka and the Tista and in the old bed of Dharla. Throughout the district the nature of the soil varies mainly between sandy loam to loam.

The soil is generally acidic in nature, because of heavy rainfall. The moisture holding capacity of soil is very low. Silty-loam and sandy-loam soil is found in the northern portion of the district. Sandy-silt soil is formed along the flood plain of the major rivers. Older alluvium soil is found far away from river courses. Newer alluvium soil is found near the river. Every year this newer alluvium is deposited over the low-lying areas. This soil is ideal for the cultivation of paddy, jute, tobacco, mustard, oil seeds etc. The turbulent water of different rivers carries huge amount of detritus material, which have an adverse effect on crop production as well as the hydrology of the study area. Depth of alluvial soil varies from 15 cm to 50 cm which is superimposed on a bed of sand. The soil has a low level of nitrogen with moderate level of potassium and phosphorus and deficiencies of zinc, calcium and magnesium. The amount of nutrient is very much high in the soil. In Koch Bihar district sandy- clay -loam soil (sand-54%, silt-34%, clay 12%) is predominant.

Fig-1.3. Soil Textural Triangle



It is observed from the textural triangle that Koch Bihar-I & II, Dinhata-I & II and Mathabhanga-I blocks have Loam soil; Mekhliganj, Haldibari, Mathabhanga-II and Sitai blocks have Sandy Loam soil; Sitalkuchi and Tufanganj-II have Mixed soil of Sandy Loam & Loam soil; and Tufanganj-I has Clay Loam Soil which is very much suitable for brick making.

Fig-1.4: Soil Texture in Different Blocks

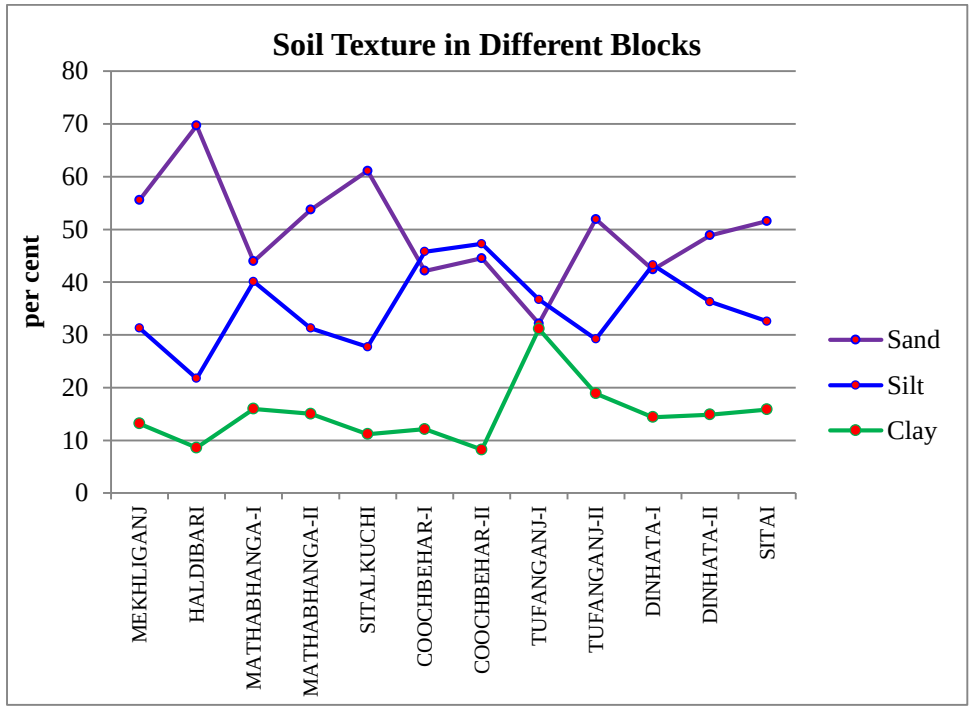


Table-1.15: Soil Texture and Soil pH in the Blocks of Koch Bihar District

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	COOCHBEHAR-I	42.12	45.78	12.10	100.00	Loam	7.10
7	COOCHBEHAR-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

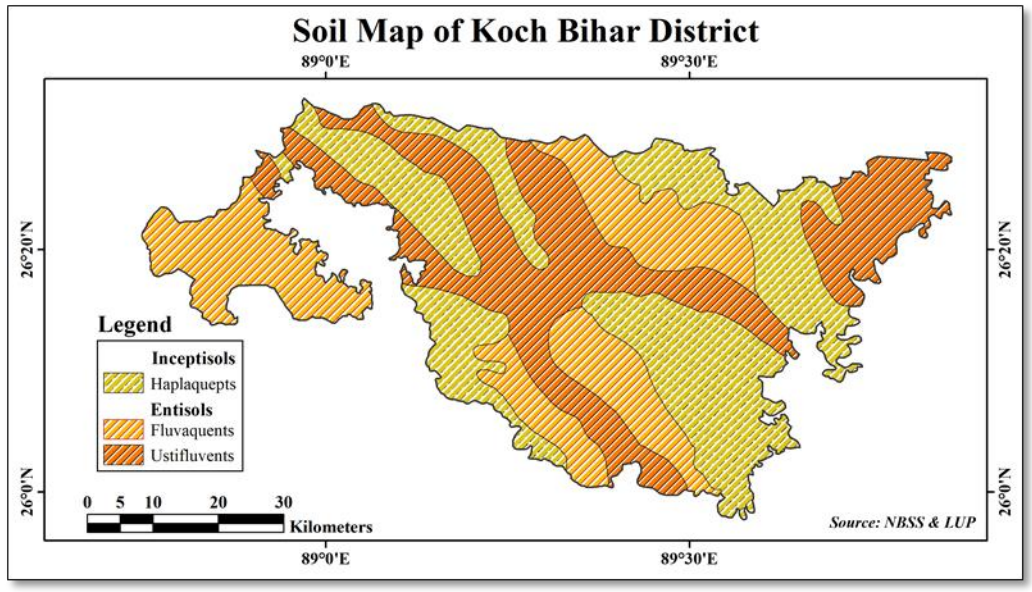
Table- 1.16: Soil pH of Different Mouzas in the Study Area

Name of the Village	pH	Organic Carbon (%)	E.C	Sand	Silt	Clay	Total Texture
CHILA KHANA	5.00	0.67	0.10	28.40	38.20	33.40	100.00
VELAKOPA-II	4.10	0.90	0.25	20.93	39.67	39.40	100.00
GHOGARKUTHI-I	4.80	0.64	0.60	30.90	37.80	31.30	100.00
SHIKARPUR	6.10	0.66	0.04	38.30	34.40	27.30	100.00
MARADNGA	5.00	0.39	0.16	23.82	31.90	44.28	100.00
SOLADANGA-II	4.92	0.57	0.15	25.32	40.50	34.18	100.00
SHIKARPUR	6.10	0.66	0.00	38.7	34.35	25.7	98.75

Source: Soil Testing Lab, Koch Bihar

One of the most important physiological characteristics of the soil solution is its reaction. Soil pH is a scale through which soil reaction may be estimated. The pH value of surface soil of the study region has been depicted in the Fig-1.5. It has been identified that the most of the soil of the study area are acidic to neutral in nature. The soil is highly acidic in Sitalkuchi. The lowest pH is found in Sitalkuchi Block (5.57). Neutral soil pH is observed in Mekhliganj Block (7.05), and rest of the blocks pH value ranges between 6.00 and 7.00.

Map-1.4: Soil Map of Koch Bihar



1.12.2.6. Natural Vegetation:

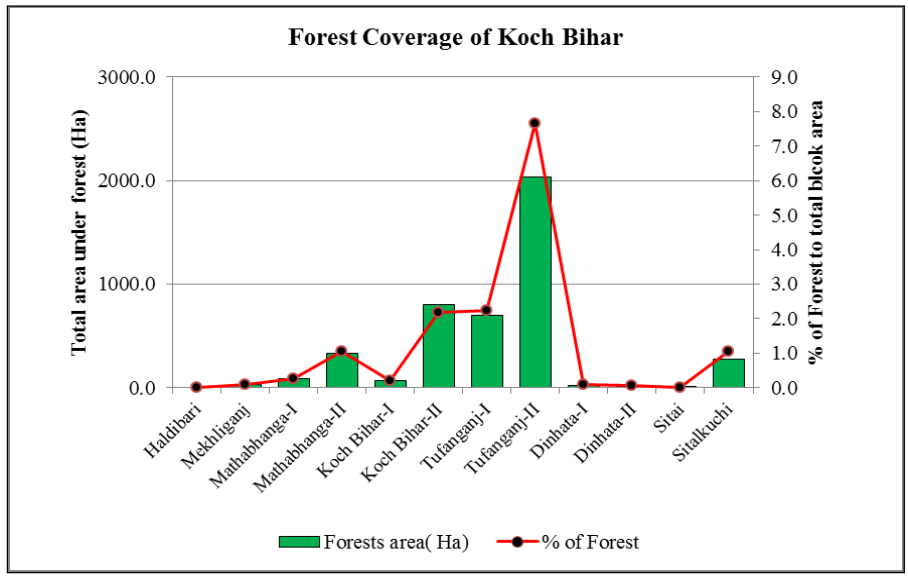
The Koch Bihar District has 5405 hectares area under forest. There were 11 small reserved forests before 1882. The forests are located in Baro Salbari, Atiamochar, Rasikbil, Rampur, Takoamari, Falimari, Chengmari, Khagrabari, Garbhanga, Paglirkhuthi and Jaldhoya. Now

the Koch Bihar District has 3 reserved forests- Patlakhawa, Rasikbil, Baro Salbari. Actually the district has no big forest. Many trees are planted along roadside, embankments and open land by Forest department. From the Fig-1.7 it is evident that Koch Bihar has only 1.3 % of forest Coverage. Tufanganj-II has the highest forest coverage (7.7%) and Haldibari has no such forest (0 %). The amount of forest covers in Koch Bihar-I 798.9 hectares and in Tufanganj-I have 701.1 hectares but the share of forest in both the villages is more or less same (2.17% and 2.23%). The predominant trees of the district are Sal (Shorea robusta), Sishu (Indian Rosewood), Bamboos (Bambusoideae), Palms (Arecaceae), Teak (Tectona grandis) Jack Fruit (Artocarpus heterophyllus), Mango (Mangifera Indiaca) and many more.

Table-1.17: Distribution of Forest in Koch Bihar (Area in Ha)

Name of the Block	Forests	Total	% of Forest
Haldibari	0.0	15238.4	0.00
Mekhliganj	31.3	30007.1	0.10
Mathabhanga-I	83.7	31939.6	0.26
Mathabhanga-II	329.2	30998.4	1.06
Koch Bihar-I	68.8	34947.0	0.20
Koch Bihar-II	798.9	36810.9	2.17
Tufanganj-I	701.1	31446.5	2.23
Tufanganj-II	2030.9	26501.1	7.66
Dinhata-I	25.0	27820.4	0.09
Dinhata-II	13.2	24697.5	0.05
Sitai	1.0	16082.1	0.01
Sitalkuchi	278.1	26250.8	1.06
Total	4361.2	332739.8	1.31
Source: District Census Handbook,2011			

Fig-1.5: Forest Coverage of Koch Bihar



Land use means the use and distribution of land for various uses. The land use pattern is determined by several interrelated factors like the environmental or physical, socio-economic and the proper management of the land use itself.

In 2011, the district has 76.17% of agricultural land, 1.28% of forest land and 19.54% of land is not suitable for agriculture. Still now, there is 2.29% old fallow land and 0.40% is Culturable waste land. Total forest land in the district is 4.26 thousand hectares. Table- 1.17 depicts that the district has 9000-hectare wetland. This wetland includes *khal, bill* and remnant river channel. Other wetland areas like ponds and tanks constitute 891.42 hectare, 60790 hectares is used for settlement, schools, and markets. Uncultivated land is 14,368 hectares, cultivated land is 246,491 hectares. The district has 99,163 hectare irrigated land. (DCHB, 2011).

Fig-1.6: Land use Pattern of Koch Bihar District

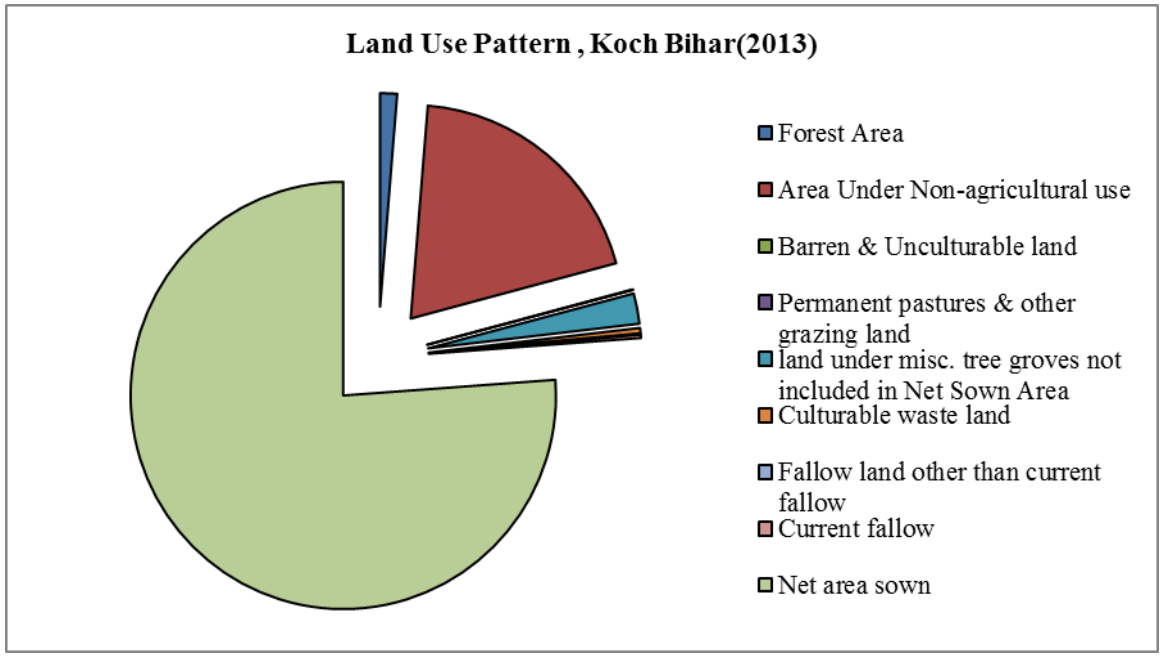


Table-1.18: Land Use Pattern of Koch Bihar District

Types of land	2008-09	Percentage (%)	2009-10	Percentage (%)	2010-11	Percentage (%)	2011-12	Percentage (%)	2012-13	Percentage (%)
Total Area(km^2)	331.57	100.00	331.57	100.00	331.57	100.00	331.57	100.00	331.57	100.00
Forest Area	4.26	1.28	4.26	1.28	4.26	1.28	4.26	1.28	4.26	1.28
Area Under Non-agricultural use	67.85	20.46	68.08	20.53	69.43	20.94	69.43	20.94	64.80	19.54
Barren & Unculturable land	1.10	0.33	0.85	0.26	0.26	0.08	0.26	0.08	0.12	0.04
Permanent pastures & other grazing land	0.01	0.00	0.03	0.01	0.01	0.00	0.01	0.00	-	
land under misc. tree groves not included in Net Sown Area	5.84	1.76	5.63	1.70	5.80	1.75	5.80	1.75	7.60	2.29
Culturable waste land	0.04	0.01	0.12	0.04	0.29	0.09	0.29	0.09	1.33	0.40
Fallow land other than current fallow	0.01	0.00	0.04	0.01	0.05	0.02	0.05	0.02	0.05	0.02
Current fallow	0.50	0.15	1.20	0.36	0.86	0.26	0.86	0.26	0.85	0.26
Net area sown	251.96	75.99	251.36	75.81	250.61	75.58	250.61	75.58	252.56	76.17

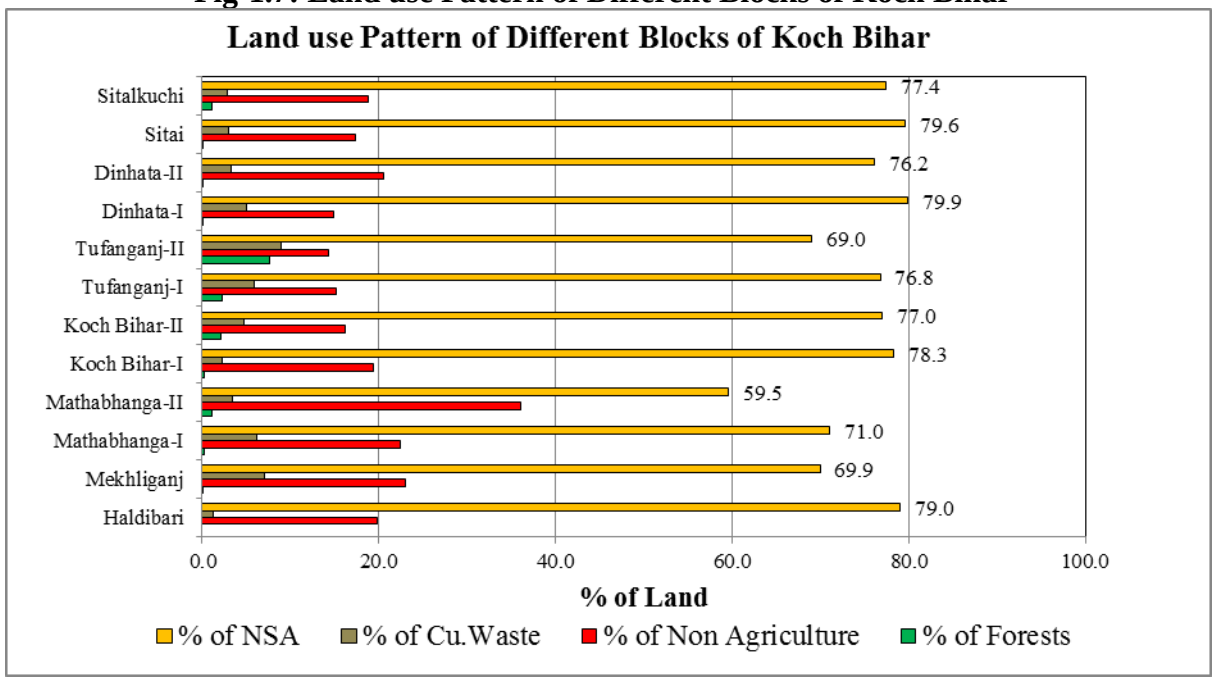
Source: District Census Hand Book

Table-1.19: Block wise Land Use Pattern of Koch Bihar District

Name of the Block	Forests		Area under Non-agricultural Uses		Culturable Waste Land		Net Area Sown		Total	
	Area in Ha	% of Forests	Area in Ha	% of Non Agriculture	Area in Ha	% of Cu. Waste	Area in Ha	% of NSA	Area in Ha	% of Land
Haldibari	0.0	0.0	3027.1	19.9	179.2	1.2	12032.1	79.0	15238.4	100.0
Mekhliganj	31.3	0.1	6893.1	23.0	2093.2	7.0	20989.5	69.9	30007.1	100.0
Mathabhanga-I	83.7	0.3	7173.7	22.5	1992.1	6.2	22690.1	71.0	31939.6	100.0
Mathabhanga-II	329.2	1.1	11161.4	36.0	1054.4	3.4	18453.4	59.5	30998.4	100.0
Koch Bihar-I	68.8	0.2	6764.6	19.4	763.5	2.2	27350.1	78.3	34947.0	100.0
Koch Bihar-II	798.9	2.2	5942.0	16.1	1737.6	4.7	28332.4	77.0	36810.9	100.0
Tufanganj-I	701.1	2.2	4771.7	15.2	1834.5	5.8	24139.2	76.8	31446.5	100.0
Tufanganj-II	2030.9	7.7	3798.4	14.3	2378.4	9.0	18293.4	69.0	26501.1	100.0
Dinhata-I	25.0	0.1	4157.9	14.9	1402.0	5.0	22235.5	79.9	27820.4	100.0
Dinhata-II	13.2	0.1	5069.2	20.5	803.6	3.3	18811.5	76.2	24697.5	100.0
Sitai	1.0	0.0	2791.6	17.4	485.8	3.0	12803.7	79.6	16082.1	100.0
Sitalkuchi	278.1	1.1	4917.3	18.7	737.2	2.8	20318.2	77.4	26250.8	100.0
Total	**4361.2**	**1.3**	**66468**	**20.0**	**15461.5**	**4.6**	**246449.1**	**74.1**	**332739.8**	**100.0**

Source: DCHB, 2011

Fig-1.7: Land use Pattern of Different Blocks of Koch Bihar



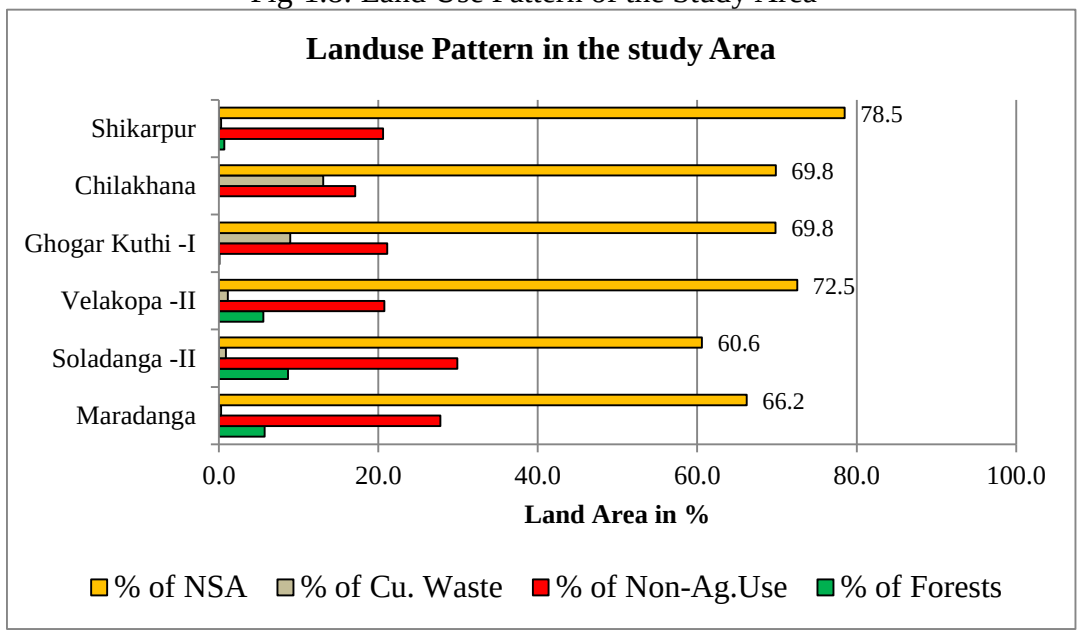
The census of India (2011) has classified land use by 9 categories out of which four categories are prevalent in Koch Bihar district such as Forests, area under Non agricultural uses, Culturable waste land and Net Sown Area. It is evidenced from the Table No 1.19 and Fig-1.7 that the Net sown area of the district is 74.1% followed by area under non-agricultural use (20%). The lowest share of land use is covered by forests (1.3%) followed by Culturable Waste lands (4.6%). Among all the blocks, Dinhata-I (79.9) has the highest NSA followed by Sitai (79.6%) and least NSA is found the block of Mathabhanga-II (59.5%). Haldibari has no forest and Tufanganj –II has the highest forest coverage (7.7%) followed by Tufanganj-I (2.23%).

Table-1.20: Land Use Pattern of the Study Area

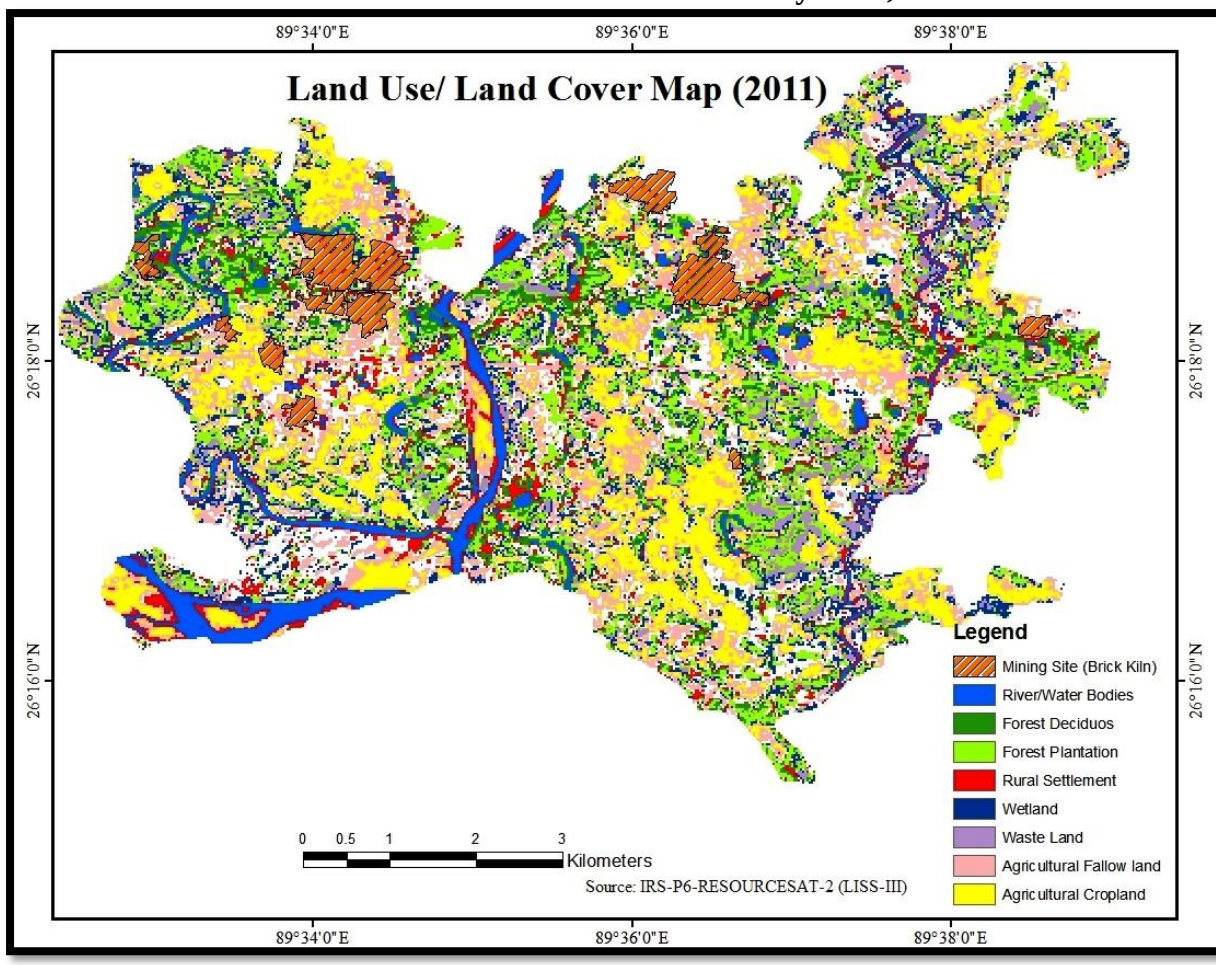
Name of The Mouza	Forests		Area under Non-agricultural Uses		Culturable Waste Land		Net Area Sown		Total	
	Area in Ha	% of Forests	Area in Ha	% of Non-Ag. Use	Area in Ha	% of Cu. Waste	Area in Ha	% of NSA	Area in Ha	% of area
Maradanga	42.0	5.7	203.5	27.8	2.0	0.3	485.0	66.2	732.5	100.0
Soladanga -II	10.0	8.7	34.6	29.9	1.0	0.9	70.0	60.6	115.6	100.0
Velakopa -II	10.0	5.6	37.2	20.8	2.0	1.1	130.0	72.5	179.2	10.0
Ghogar kuthi -I	1.0	0.1	235.8	21.1	100.0	9.0	779.0	69.8	1115.8	100.0
Chilakhana	0.0	0.0	102.0	17.1	78.0	13.1	417.0	69.8	597.0	100.0
Shikarpur	0.8	0.7	24.1	20.6	0.3	0.3	92.1	78.5	117.3	100.0
Total	78.8	2.5	731.6	23.4	183.3	5.9	2133.1	68.2	3126.8	100.0

Source: DCHB, 2011

Fig-1.8: Land Use Pattern of the Study Area



MAP-1.5. Land Use Pattern of the Study Area,2011



From Table-1.20 and Fig-1.8 it is observed that the land use pattern in the study area has significantly differed from the district Average. The NSA in the study area is 68.2 which are lower than the district Average (74.1%). All the mouzas except Shikarpur show the NSA 60.6 % to 72.5%. Shikarpur shows the maximum value as compared to the district as because there is only one brick kiln (SUN) is operating. District's average Non-agricultural use is 20% but in the study area it is 23.4%. This implies that the agricultural land is being converted or deteriorated by the brick kilns.

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Forests	18	4,440.00	246.67	2,56,521.13
Area under Non-agricultural Uses	18	67,199.60	3,733.31	1,03,05,200.96
Culturable Waste Land	18	15,644.80	869.16	7,01,609.07
Net Area Sown	18	2,48,582.20	13,810.12	11,18,83,430.63

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	2,13,17,65,362	3	71,05,88,453.98	23.08	0.0000000002	2.73950
Within Groups	2,09,34,94,950	68	3,07,86,690.45			
Total	4,22,52,60,312	71				

Source: DCHB, 2011 and Computed by the Researcher

Analysis of variance (ANOVA) has been done among the various blocks of Koch Bihar district and mouzas of the study area under the provision of Ho= There is no significance variations of the of the land use pattern between these two groups. From the above calculation it is evident that the F-statistic of ANOVA at d.f. 23 (between the groups) and 68 (within the groups) in 95% confidence level is 23.08 which is greater than the critical or tabulated value (2.73950). Thus, the null hypothesis is rejected and it may be concluded that the land use pattern of the district and that of the study area varies significantly.

1.12.3. Socio-Cultural Background:

1.12.3.1. Demography:

The native of Koch Bihar is Koch or *Rajbanshi* communities who have originally spread from entirely different sources. The 'Koches' are the Mongoloid but the '*Rajbanshis'* are the

Dravidian tribes. Thus, Koch and *Rajbanshi* are racially different but in Koch Bihar they are mingled with each other.

In 2011, census the total populations if the district is 28, 19, 086 of which male and female are 1,451,542 and 1,367,544 respectively. In 2001 census, Koch Bihar had a population of 2,479,155 of which males were 1,272,094 and remaining 1,207,061 were females. There was change of 13.71 percent in the population compared to population as per 2001. In the previous census of India 2001, Koch Bihar District recorded increase of 14.19 percent to its population compared to 1991. The population density of Koch Bihar district in 2011 was 832 people/ sq. km. In 2001, Koch Bihar district density was at 732 people /sq. km. With regards to Sex Ratio in Koch Bihar, it has 942 females per 1000 males as compared to 2001 census figure of 949. The average national sex ratio in India is 940 as per latest reports of Census 2011. In 2011 census, child sex ratio is 948 girls per 1000 boys compared to figure of 964 girls per 1000 boys of 2001 census data. Average literacy rate of Koch Bihar in 2011 were 74.78 compared to 66.30 of 2001. If things are looked out at gender wise, male and female literacy were 80.71 and 68.49 respectively in the year 2011.

Out of the total Koch Bihar population for 2011 census, 10.27 percent lives in urban. In total 289,434 people lives in urban areas of which males are 146,626 and females are 142,808. Sex Ratio in urban region of Koch Bihar district is 974 as per 2011 census data. Child population (0-6) in urban region was 25,420 of which males and females were 13,125 and 12,295. This child population figure of Koch Bihar district is 8.95 % of total urban population.

As per 2011 census, 89.73 % population of Koch Bihar districts lives in rural areas. Out of 2,529,652 rural populations, 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. If child sex ratio data of Koch Bihar district is considered, figure is 949 girls per 1000 boys. Child population in the age 0-6 is 319,225 in rural areas of which males were 163,815 and females were 155,410. The child population comprises 12.55 % of total rural population of Koch Bihar district. Literacy rate in rural areas of Koch Bihar district is 73.16 % as per census data 2011.

About 86.5% persons are being dependent on agriculture and agriculture related activities, 4.9% on industries and 8.6 % are on the other professions whereas in 2001 the total workers are 38.5 % of which 14.16 % were cultivators, 11.51 % were agricultural labourers,

1.53 % was household industry workers and 11.3 % are in other workers. The main workers, marginal and non- workers comprise of 30.42%, 8.57%, and 61% respectively in 2001. 90.90% of the total population lives in rural areas. (Census,2001 and 2011).

Table- 1.22: Koch Bihar District at a Glance

Description	2011	2001
Actual Population	2,819,086	2,479,155
Male	1,451,542	1,272,094
Female	1,367,544	1,207,061
Population Growth	13.71%	14.19%
Area Sq. Km	3,387	3,387
Density/km2	832	732
Proportion to West Bengal Population	3.09%	3.09%
Sex Ratio (Per 1000)	942	949
Child Sex Ratio (0-6 Age)	948	964
Average Literacy	74.78	66.30
Male Literacy	80.71	75.93
Female Literacy	68.49	56.12
Total Child Population (0-6 Age)	344,645	387,130
Male Population (0-6 Age)	176,940	197,118
Female Population (0-6 Age)	167,705	190,012
Literates	1,850,504	1,386,965
Male Literates	1,028,733	816,196
Female Literates	821,771	570,769
Child Proportion (0-6 Age)	12.23%	15.62%
Boys Proportion (0-6 Age)	12.19%	15.50%
Girls Proportion (0-6 Age)	12.26%	15.74%

Source: Census of India, 2001 & 2011

Table-1.23: Population Structure of the Study Area

Census	Place	Total population			Population (0-6)			Literates		
		Persons	Males	Females	Persons	Males	Females	Persons	Males	Females
2001	Ghogarkuthi -I	9,905	5,112	4,793	1,358	697	661	5,843	3,459	2,384
	Chilakhana	8,357	4,237	4,120	1,371	687	684	4,396	2,568	1,828
	Maradanga	7,809	4,050	3,759	1,063	558	505	4,743	2,761	1,982
	Soladanga -II	671	342	329	99	49	50	422	245	177
	Velakopa-II	1407	728	679	212	115	97	666	405	261
	Shikarpur	1,938	979	959	199	101	98	1,274	755	519
	Total	30,087	15,448	14,639	4,302	2,207	2,095	17,344	10,193	7,151
2011	Ghogarkuthi -I	10826	5658	5168	1089	574	515	7209	4143	3066
	Chilakhana	9263	4791	4472	1062	559	503	6010	3341	2669
	Maradanga	8775	4505	4270	1020	529	491	6135	3364	2771
	Soladanga -II	699	362	337	87	44	43	541	296	245
	Velakopa-II	1799	915	884	263	133	130	935	522	413
	Shikarpur	2265	1145	1120	209	100	109	1460	842	618
	Total	**33627**	**17376**	**16251**	**3730**	**1939**	**1791**	**22290**	**12508**	**9782**

Census	Place	Illiterates			Total workers			Non-workers		
		Persons	Males	Females	Persons	Males	Females	Persons	Males	Females
2001	Ghogarkuthi -I	4,062	1,653	2,409	3,898	2,743	1,155	6,007	2,369	3,638
	Chilakhana	3,961	1,669	2,292	2,864	2,176	688	5,493	2,061	3,432
	Maradanga	3,066	1,289	1,777	2,690	2,165	525	5,119	1,885	3,234
	Soladanga -II	249	97	152	262	216	46	409	126	283

	Velakopa-II	741	323	418	512	387	125	895	341	554
	Shikarpur	664	224	440	1,084	577	507	854	402	452
	Total	12,743	5,255	7,488	11,310	8,264	3,046	18,777	7,184	11,593
2011	Ghogarkuthi -I	3617	1515	2102	5135	3577	1558	5691	2081	3610
	Chilakhana	3253	1450	1803	3756	2741	1015	5507	2050	3457
	Maradanga	2640	1141	1499	3171	2633	538	5604	1872	3732
	Soladanga -II	158	66	92	236	216	20	463	146	317
	Velakopa-II	864	393	471	627	524	103	1172	391	781
	Shikarpur	805	303	502	1116	705	411	1149	440	709
	Total	**11337**	**4868**	**6469**	**14041**	**10396**	**3645**	**19586**	**6980**	**12606**

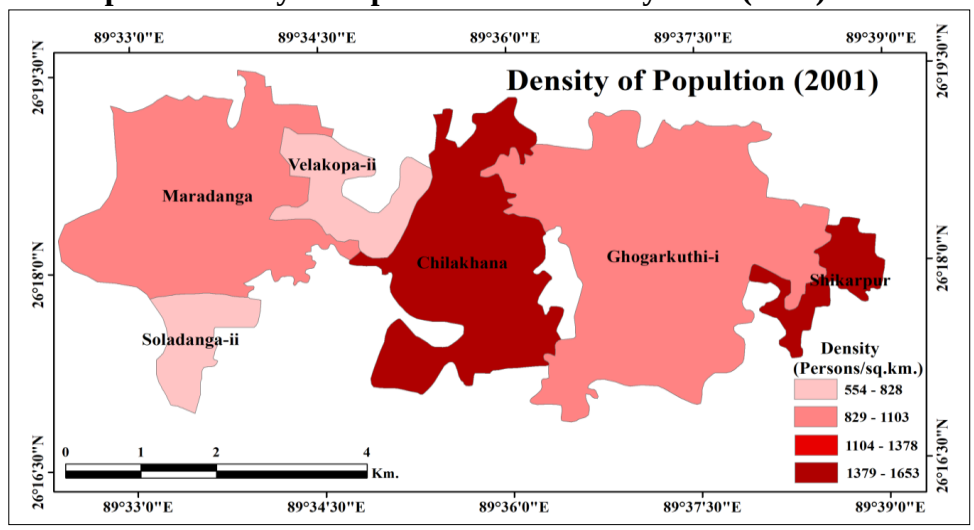
Source: Census, 2001 and 2011

Table-1.24. Density of Population and Z-Score of the Study Area

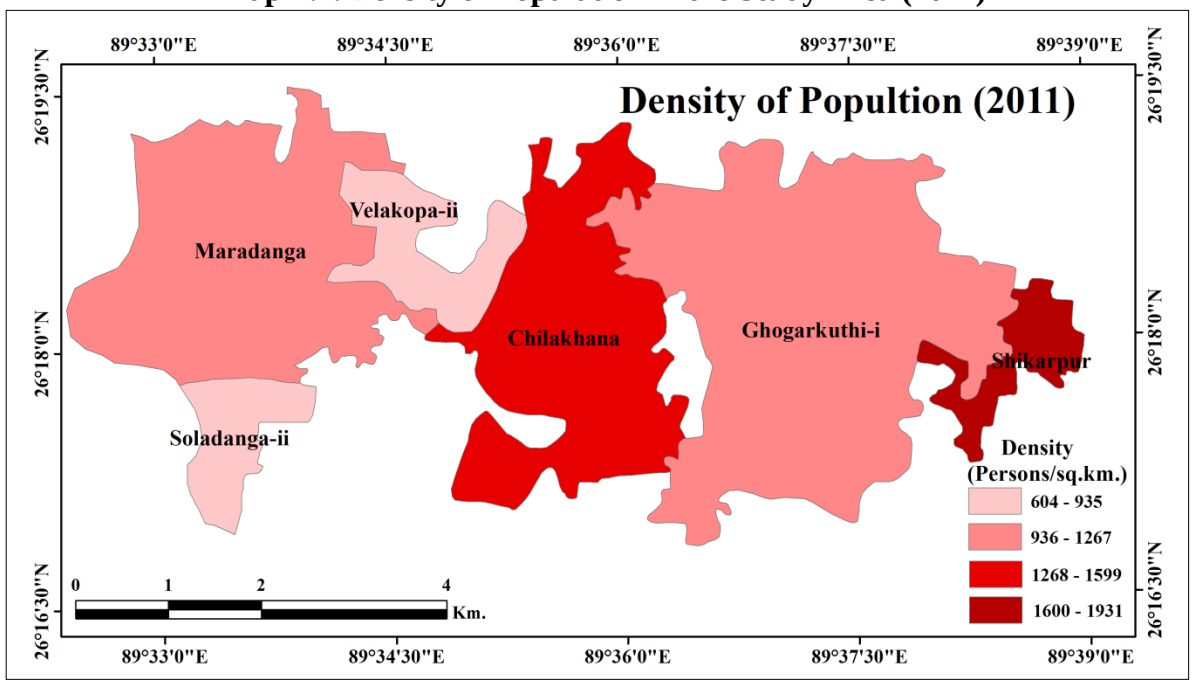
Census	Place	Total population			Z-Score		Yearly Growth in (%)
		Persons	Area (Km^2) (X)	Density (Persons/Km^2)	From Block (2001)	From District (2011)	
2001	Ghogarkuthi -I	9,905	11.2	888	0.37	0.29	0.89
	Chilakhana	8,357	6.0	1,402	1.43	1.35	1.03
	Maradanga	7,809	7.3	1,066	0.73	0.66	1.17
	Soladanga -II	671	1.2	581	-0.26	-0.34	0.41
	Velakopa-II	1,407	4.5	314	-0.81	-0.89	2.49
	Shikarpur	1,938	1.2	1,652	1.94	1.87	1.57
	Study Area Total	**30,087**	**31.3**	**963**	**0.52**	**0.45**	**1.12**
	Tufanganj-I(X1)	**2,23,088**	**314.47**	**709**	**0.00**	**-0.07**	**1.09**
	District(X2)	**24,79,155**	**3327.40**	**745**	**0.07**	**0.00**	**1.29**
2011	Ghogarkuthi -I	10,826	11.2	970	0.32	0.23	
	Chilakhana	9,263	6.0	1,554	1.35	1.33	
	Maradanga	8,775	7.3	1,198	0.72	0.66	
	Soladanga -II	699	1.2	605	-0.33	-0.45	
	Velakopa-II	1,799	4.5	401	-0.69	-0.84	
	Shikarpur	2,265	1.2	1,930	2.01	2.03	
	Study Area Total	**33,627**	**31.3**	**1,076**	**0.50**	**0.43**	
	Tufanganj-I (X1)	**2,48,595**	**314.47**	**791**	**0.00**	**-0.11**	
	District(X2)	**28,19,086**	**3327.40**	**847**	**0.10**	**0.00**	

Source: Census, 2001 and 2011

Map-1.6. Density of Population in the Study Area (2001)

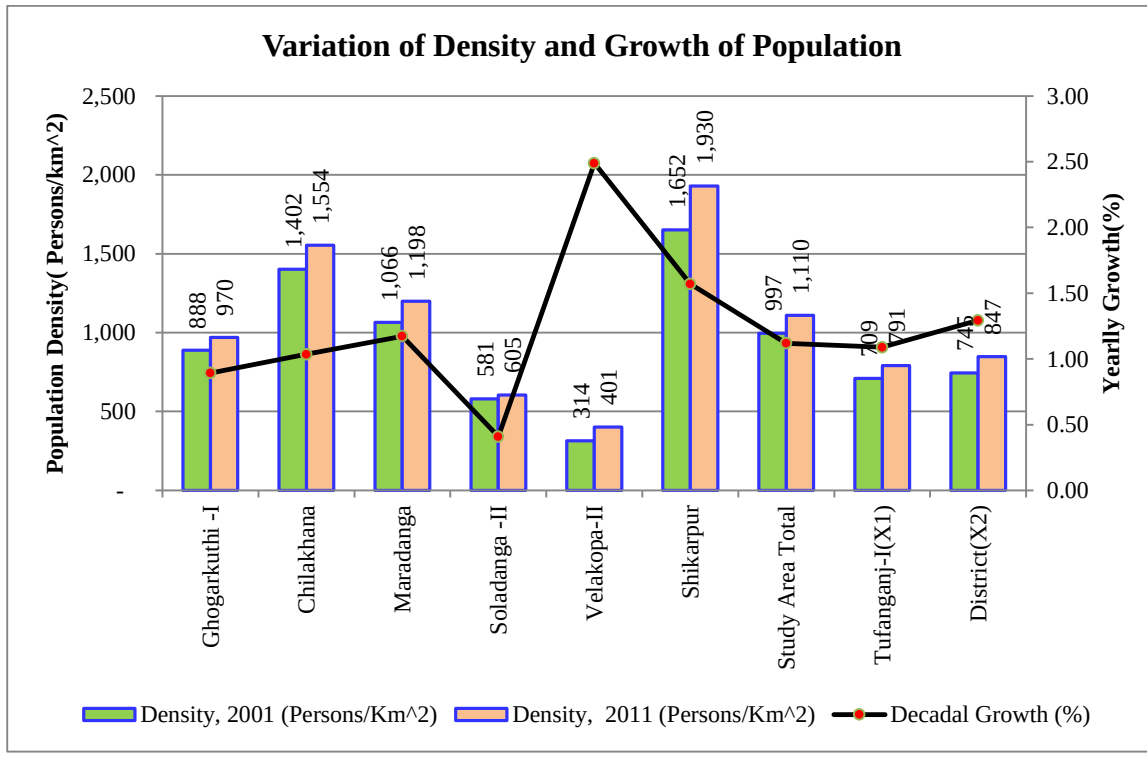


Map-1.7. Density of Population in the Study Area (2011)



From the map 1.6 and 1.7, it is evident that the density of population has changed significantly as compared to the Tufanganj-Block-I and Koch Bihar District. There is less variation of density of the block as compared to the district (-0.07 and -0.11 in 2001 & 2011). Shikarpur is located at the vicinity to the Tufanganj town and hence the density is high (1652 and 1930 persons/km^2 in 2001 and 2011) followed by Chilakhana and Maradanga. Velakopa-II and Soladanga-II show the lowest density during the both census periods. Yearly growth of population of the district was 1.29 % whereas Shikarpur and Velakopa have the higher growth of population as compared to the district.

Fig-1.9. Variation of Density and Growth of Population



1.12.3.2. Literacy:

Education is a reasonable and good indicator of development. Education for all declares that everyone has the right to education. Education for all means extended education opportunities to all, regardless of race, colour, sex or ability. In 1993, the supreme court of India declared that education up to 14 years' age is to be considered as a fundamental right of children in India

Koch Bihar district has expressed a strong commitment towards education for all. Focus of the development is on backward areas and backward classes while girls are encouraged to enroll and discouraged from dropping out by involving panchayet and local bodies. Growth rate of female literacy in Koch Bihar district is 1.298%/ year (Census-2011) which is greatly higher than national female literacy rate i.e. 0.866%/year. However, the overall female literacy in Koch Bihar 69.08% (Census, 2011) shows the poorest condition of literacy among women.

Table -1.25: Population Growth and Literacy

YEAR	Population Growth rate	Literacy Rate			Growth Rate of Literacy		
		Total literacy rate	M	F	Total	Male	Female
1951	4.74	17.1	26.1	6.1			
1961	52.45	25.4	37.4	11.4	8.3	11.3	5.3
1971	38.67	26.5	37.0	14.6	1.1	-0.4	3.2
1981	25.28	34.8	46.1	22.6	8.3	9.1	8
1991	22.55	45.8	57.4	33.3	11	11.3	10.7
2001	14.19	66.3	75.9	56.1	20.5	18.5	22.8
2011	13.86	75.49	81.51	69.08	9.19	5.61	12.98

Source: Census, 1951-2011

Out of the total population (excluding the 0-6 age group population), the literacy rate has increased to 75.49% in 2011 from 17.1% in 1951.The literacy rate in the country has increased 65.38% in 2001to74.4% in 2011.The female literacy rate has also increased from 39.29% in 1991 to 54.16% in 2001, Now it is 65.46%.

In Koch Behar district the literacy rate increased 45.78 % in 1991 to 66.31% in 2001 and in 2011 the rate of was 75.49. It is noticed that the female literacy during the period 2001-2011 has increased by 12.04%. Whereas male literacy has rose by 4.69%. Recent data indicate that the last 5 decades' women education has increased and overall growth rate was 12.98% (2011) It also observed that higher women literacy growth rate was observed in 2001(22.8%).

Fig 1.10: Relation between Literacy and Population Growth

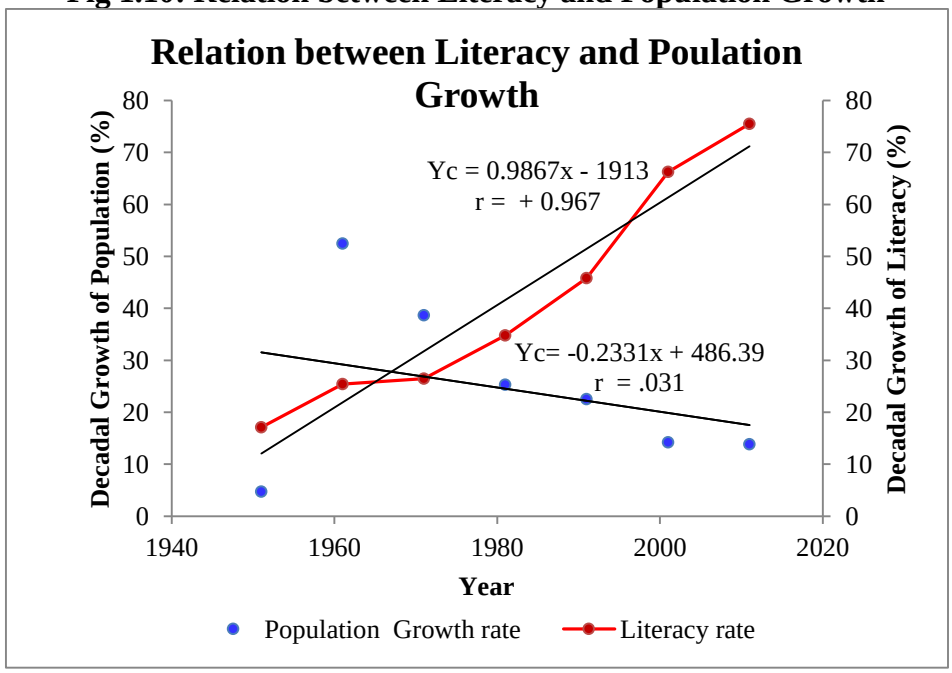
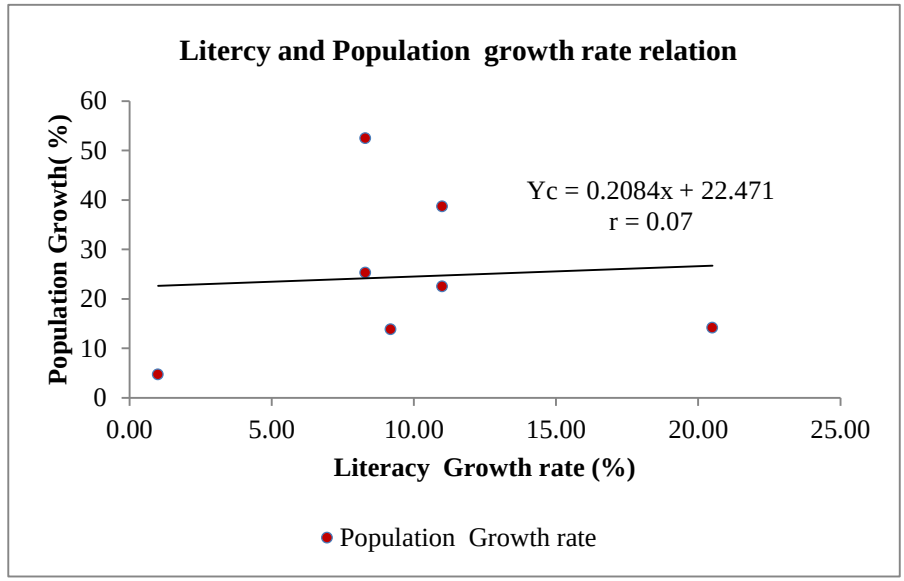


Fig-1.11: Literacy Growth Rate and Population Growth Rate



From Fig 1.10 and Fig-1.11 it is observed that decadal growth rate of population is declined significantly over time and rate of literacy is increased significantly. The coefficient of regression value for literacy rate is +0.967 and population growth rate is +.031. This indicates that the literacy is growing at faster rate but the growth of population is declined at slower rate. Further, it is also observed from the fig-1.10 that there is no relationship between population growth and literacy growth as regression coefficient is +0.07. This indicates that the growth of population is affected not only by the rate of literacy but by other factors also.

1.12.3.3. Occupational Structure:

Occupational structure defines to the distribution of working force in to the various sectors of economic activity. Working force refers the population engaged in various productive activities in an economy.

According to the Census (1981) the main workers are those who are engaged in economically productive activity for a major part of the preceding year (at least six month or 183 days), whereas marginal workers mean those who worked for sometimes (less than 183 days). In 2001, the total worker of Koch Bihar District was 9, 66,705 (38.99 % to total population) and increased to 11, 27.977 (40.01 % to total population).

The share of male workers was 54.91% and female workers was 22.22 % in respect of total male and female population in 2001 where as the male worker increased to 58.24 % but the share of female workers declined to 20.67 % in 2011.

Table-1.26: Working Population

Place	PERSONS		MALE		FEMALE	
	2001	2011	2001	2011	2001	2011
Population of 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, Population	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

In Tufanganj-I the total worker was 76,418 (34.25% to total population) and it increased to 1, 00, 657 (40.49 %) in 2011. The male worker was 53.54 % and female worker was 14.17 % which increased to 59.48 % male and 20.20 % female respectively. The different type of working population of Koch Bihar District has been diagrammatically represented in Fig-1.23

The data and chart of the different types of worker of Tufanganj-I in 2001(Fig-1.12) indicate that the maximum worker engaged in agricultural activities i.e. cultivators (31.47% of total worker) and agricultural labourers (26.53%), others worker carried 29.32%, household industry (12.88%) where as in 2011 the agricultural labourer increased to 34.95% and cultivators to 24.69%, other workers 30.42 %, household industry 9.94% respectively.

A Lorenz curve has been prepared on the basis of total population and total workers in the study area. The Fig-1.13 depicts that the distribution of the workers in the study area is evenly distributed as the values of Gini's coefficient is 0.04.

Table-1.27. Main Workers

Place	Year	Cultivators	Agricultural Labourers	Household Industry	Other Workers	Total Worker
Koch Bihar	2001	361840	285426	39255	280184	966705
		37.43	29.53	4.06	28.98	100
	2011	364797	391875	40593	330712	1127977
		32.34	34.74	3.6	29.32	100
Tufanganj-I	2001	24050	20270	9843	22255	76418
		31.47	26.53	12.88	29.12	100
	2011	24856	35176	10007	30618	100657
		24.69	34.95	9.94	30.42	100
Study Area	2001	1,998	1,478	2,084	3,758	9,318
		21.44	15.86	22.37	40.33	100.00
	2011	1,679	2,461	1,753	5,297	11,190
		15.00	21.99	15.67	47.34	100.00

Source: Census, 2001 and 2011

Fig-1.12. Categories of Workers

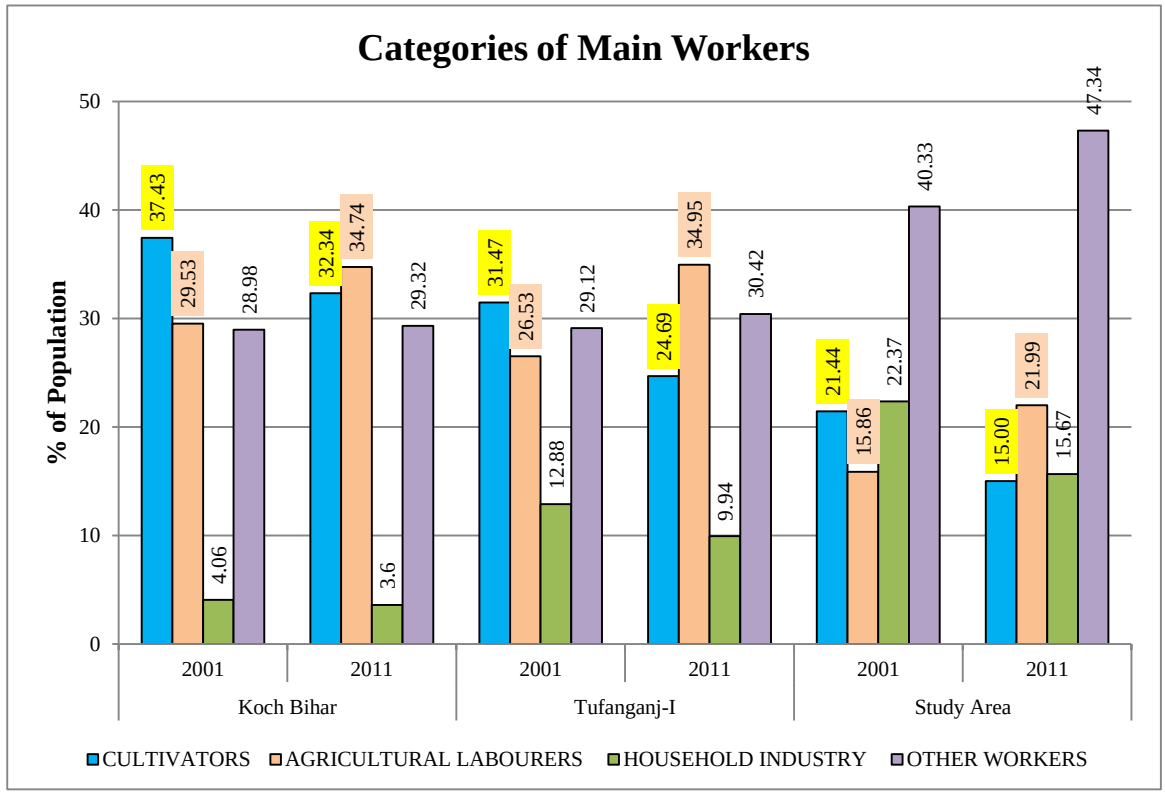


Fig-1.13. Lorenz Curve showing the Total Population and Total Workers in the Study Area

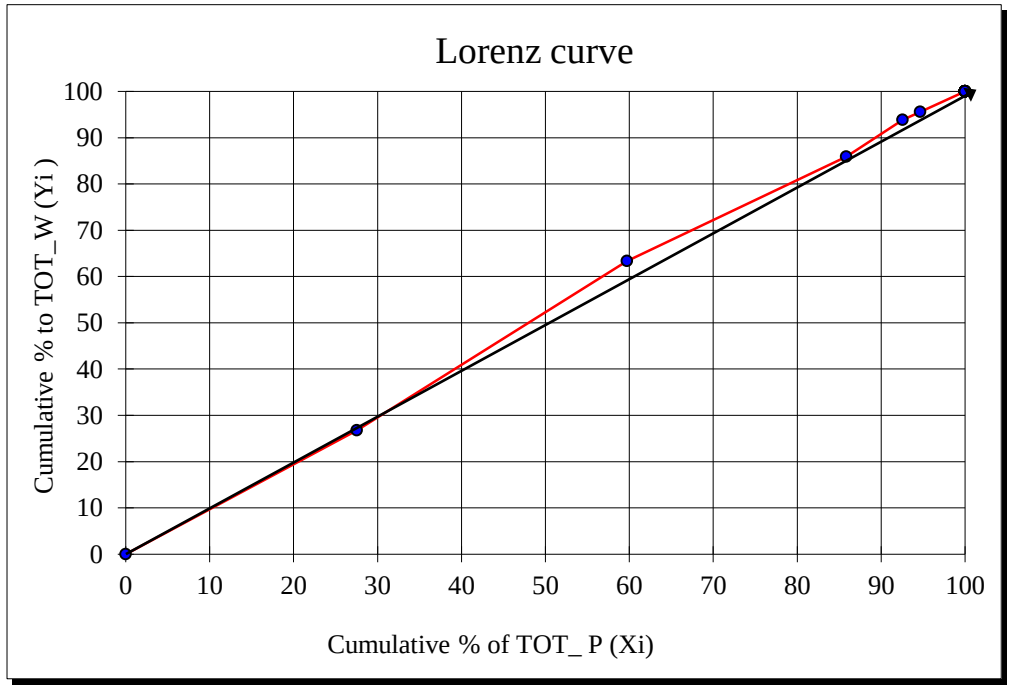


Table-1.28. Dominant and Distinctive Function

Place	Year	Cultivators (CL)	Agricultural Labourers (Ag. L)	Household Industry(HH)	Other Workers(OW)	Distinctive Function
Koch Bihar	2001	37.43	29.53	4.06	28.98	None
Tufanganj-I	2001	31.47	26.53	12.88	29.12	None
Study Area	2001	21.44	15.86	22.37	40.33	HH1, OW1
	Mean	30.11	23.97	13.10	32.81	
	Standard Dev(σ)	8.08	7.18	9.15	6.51	
Place	Year	Cultivators (CL)	Agricultural Labourers (Ag. L)	Household Industry(HH)	Other Workers(OW)	Distinctive Function
Koch Bihar	2011	32.34	34.74	3.6	29.32	CL 1
Tufanganj-I	2011	24.69	34.95	9.94	30.42	None
Study Area	2011	17.72	22.50	15.19	44.59	OW 1
	Mean	24.92	30.73	9.58	34.78	
	Standard Dev(σ)	7.31	7.13	5.80	8.51	

Source: Census 2001 and 2011

Table-1.29. Scale of Distinctiveness

2001		2011	
Cultivators	**Score**	**Cultivators**	**Score**
38.19-46.27	1	32.23-39.54	1
46.27-54.35	2	39.54-46.85	2
> 54.35	3	>46.85	3
Ag. Lab	**Score**	**Ag. Lab**	**Score**
31.16-38.34	1	37.86-44.98	1
38.34-45.52	2	44.98-52.11	2
>45.52	3	>52.11	3
HH Ind	**Score**	**HH Ind**	**Score**
22.16-31.41	1	15.38-21.18	1
31.41-40.57	2	21.18-26.98	2
>40.57	3	>26.98	3
Oth.W	**Score**	**Oth.W**	**Score**
39.32-45.84	1	43.29-51.81	1
45.84-52.35	2	51.81-60.32	2
>52.35	3	>60.32	3

In case of distinctive function, it appears that (Table 1.28 & 1.29) in 2001 all functions were diversified in nature in the district, block but in the study area household industry and other workers were dominant and distinctive function. Of the three places having distinctive functions in 2011, Koch Bihar has one distinctive function i.e. cultivators and Tufanganj-I is the diversified in nature. But in the study area other workers were dominant and distinctive function. It indicates that the workers in the study area are more concentrate on household industry and other workers rather than cultivators and agricultural Labourers.

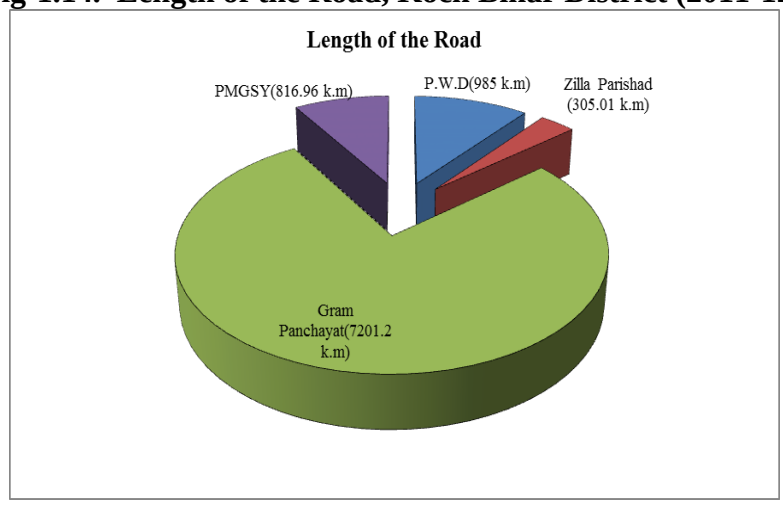
1.12.3.4. Transport and Communication:

Transport is a life line of the development of trade and commerce, agriculture and industry of a region. The district is a well networked one with NH31 which is connected with Jalpaiguri, Darjeeling and Dhubri districts. The total length of the NH31 is 65 kms which runs through Koch Bihar-II, Tufanganj-I and Tufanganj-II. The total length of State Highway is 132 Kms which is maintained by Public Works Department (PWD). State highway (SH-12A) connected with Changrabandha, Mathabhanga, Koch Bihar, Baneswar and Alipurduar. One railway station New Koch Bihar (NCB) was set up in Koch Bihar. The total length of the road is 985km in 2011-12 in which village roads is 295 km. (Census, 2001 and 2011)

The North Bengal Sate Transport was established in 1960. It serves the entire district as well as the other districts of North Bengal.

During the Maharaja's administration, there was a small airport in Koch Bihar District. After a long time, very recently the airport is newly renovated and hopes that it will start its air trips at the earliest possible moments.

Fig-1.14. Length of the Road, Koch Bihar District (2011-12)



1.12.3.5. Industry:

Koch Bihar is an agrarian district. There is no large and medium scale industry that could be developed in Koch Bihar district. But some small scale industries like food product, tobacco product, textile, warehousing etc, are developed at Chakchaka industrial belt and the most important unorganised industry is brick manufacturing which were developed in Tufanganj-I, Tufanganj-II, Koch Bihar –I and Mathabhanga. Total number of brick kilns is 40 in which 24

kilns are developed in Tufanganj-I block. Some traditional small skill based industry like sitalpati, bidi making, handloom, weaving, bamboo craft, plywood factories are developed in different parts of the district.

In 2011-12, there were 34 factories or industrial units comprising 8322 lakh fixed capital, 12349 invested capitals, 3627 employees and 1127 thousand man days employed. The total industrial units are 34 where 5 factories manufacture food products, 4 manufacture tobacco product, 2 manufacture of textile, 12 manufacture wood products, 1 manufactures non-metallic mineral products and 10 are warehousing and provide support activities for transportation.

In 2001, an industrial area was set up by WBIIDC in Chakchaka, Koch Bihar-I. The estate comprises 131 acre of land in which 64 acres are preferred for industrial sector. Some small scale industries are constructed in Tufanganj, Mathabhanga, Dinhata, Haldibari and Mekhliganj. Different small scale unorganised sectors like sitalpati, bidi making, pottery, jewellery, rice mill, wooden product, furniture, grill factories are developed scattered all over the place of this district.

Table-1.30. Selected Characteristics of Factories by Industry Group in the District for the Year 2010-11.

Industries	No. of factories	Fixed Capital (Rs. in Lakh)	Invested Capital (Rs. in Lakh)	No. of Employees	Man days employed (in thousands)
Manufacture of Food Products	5	1011	1889	322	95
Manufacture of Textiles	4	14	135	907	267
Manufacture of wood and products of wood and cork, except furniture	2	4955	6642	1674	569
manufacture of articles of straw and plaiting materials	12	372	1685	394	112
Manufacture of other non-metallic mineral products	1	10	25	10	3
Warehousing and support Activities for transportation.	10	1960	1973	320	81
Warehousing and support Activities for transportation.	34	8322	12349	3627	1127

Source: DCHB, 2011

1.13. Conclusion:

The present chapter is, thus, highlights about the history of brick making, statement of the research problem, rationale of the study, objectives, hypothesis, databse and methodology, general background of the study area and limitations of the study.

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