CHAPTER 2
BACKGROUND: HISTORICAL AND GEOGRAPHICAL

2.1. Jorhat Town through the History

“Study the past if you would define the future.” — Confucius.

Each town, whether in America, England, Canada or China, has its own story to tell. It becomes so important to look back into the history of a town so as to get an insight of the originalities that existed and the way it transformed through the time.

Researching the local history of the town, village or city where our ancestors lived is a big step toward understanding what their life was like - the people, places and events that impacted the course of their own personal history (Powell, 2014).

The study area of Jorhat town has been a vibrant place and is a perfect mixture of tradition and modernity. The town treaded through several major events of history and thereby attained its location and attributes which has been accounted here in the succeeding paragraphs.

2.1.1. The advent of the Ahoms

Chao Lung Chukapha was the first of Ahom king who entered Assam from the northeastern part of India from the Shan province of Mayang in Upper Burma (Myanmar). He established his capital at Chraideo in 1228 AD. During the time of Swargadeo Sukleng Myung (1539-62) the capital of Assam was shifted from Chraideo to Gorgaon and later on to Rongpur (Sibsagar) during the reign of Swargadeo Rudra Singha (Gogoi, 1997).

2.1.2. Jorhat in the Moamari Rebellion

When the Moamoria Rebellion began in 1794, Swargadeo Gaurinath Singha shifted his capital to Disoibahor, now Jorhat. It happened that, the Moamoria revolt gained momentum as several disgruntled princes and nobleman joined the revolt and
this shook the very foundation of the Ahom Kingdom of Assam. Purnananda Buragahain, the then most powerful Prime Minister in the royal court of the Ahoms, had to bear the brunt of the revolt. Therefore, he established many Koths or forts to encounter the Moamorias. He built two such forts on the two banks of the stream Dessoi (Bhogdoi). Earlier in the year, 1789 he established a camp on the western bank of the Dessoi and called it Dessoi Bahar, from which he directed the fight against the rebels. It was that Dessoi Bahor where the capital was shifted.

2.1.2.1. Derivation of the name Jorhat

The stream Dessoi was dug and made to flow by the new capital during the reign of Purnananda Buragahain, the then most powerful Prime Minister. While digging the stream, eatable called bhog was offered to propitiate the river goddess. From this, the stream came to be known as Bhogdoi. Two markets called Chokihat and Masarhat grew up near the forts. From these two (jor), markets (hat), the new capital came to be called Jorhat (Baruah, 1997).

2.1.2.2. British making an entry

Ahom King Gaurinath appealed to the British in Bengal for help. It was in 1792-93, British deputed Captain Welsh with a regiment of infantry to assist the Ahom King Gaurinath Singh, to quell a rebellion by Mayamara Vaishnavites. When he arrived, the Raja had already fled upper Assam. The whole country was in a state of rebellion and anarchy. “The Raja had fled to Guwahati – driven by the Muttoks (inhabitants of the country round Debrooghar) and disciples of the Moamariah Gosains joined by other priests and followers of Vaishnavite sattras west of Dihing. They had captured the capital, Gargaon and held sway. During the three years the British regiment remained in Assam and Captain Wales almost restored the complete ascendancy of the authority of
the Ahom King or rather a council of State. But expedition under him had to return into British territory in 1790 with due orders of Governor General Sir John Shore.

2.1.3. Jorhat during Burmese Invasion

Gaurinath Singha, then from the new capital of Jorhat, tried to hunt down all those previously involved in the Moamaria rebellion. The Bura-Gohain (prime-minister) set up an army on the model of the British regiment, and brought back order into the chaos.

In the meanwhile, Raja Gaurinath Singh was seized with a mortal illness and died on 19th December 1794 and Kinaram (Kamaleshwar Singh) succeeded. Later on, on the death of Kamaleswar Singha, his young brother Chandrakanta Singha who was then aged 16 years only succeeded to the throne and Purnananda Buragohain, then Prime Minister became more powerful and ran the administration as a de-facto king.

Then, followed 20 years of peace and prosperity under the ‘reign’ of the Bura Gohain who then became the virtual ruler of the land.

Dr. J.P. Wade, who visited Jorhat at that time described that “Jorhat is eight miles in length and six miles in breadth. Dhuli bound it on the west, on the south by the highway, which leads from Kaliabar to the capital Rangpur, in the east by the Dessoi River and on the north by Khotia Pota, Gayan Gaon and Ariadhera Gaon were the principal town”.

It was in 1816, one Badan Chandra Phukan, appointed as Bor Phukan of Gauhati sought the help of Burmese King to oust Bura-Gohain from Jorhat as the later was determined to eliminate him. In 1816, Burmese army of about 16000 men attacked from the South. At this point of time, Purnananda Buragohain died and his son Ruchinath was appointed Buragohain. A battle was fought by the army of the new Bura Gohain but the Burmese were victorious occupying Jorhat and retained Chandrakanta as the King. With this defeat Ruchinath Burha Gohain, fled to Gauhati. At this time, the king
appointed Badan Chandra Phukan as his Prime Minister with the new designation “Mantri Phukan”. The Burmese army was sent back in April 1817 with a great amount of compensation (Sinha, 2012).

After the departure of the Burmese, differences cropped up in between the Mantri Phukan and Dhani, the Barbaruah. As a result, Mantri Phukan was murdered and the king invited Ruchinath Buragohain to return to Jorhat for resuming charges. Ruchinath declined the offer and sent down his brother Jagannath Dhekial Phukan to invite Prince Purandar Singh, son of Brajnath Konwar from Chilmari to return to Assam and take charge of the country’s administration. Later on, Brajanath and Ruchinath raised a force consisting of four companies under the command of Jagannath Dhekial Phukan and marched towards Jorht. Purandar Singha was made king by the Ruchinath Bura Gohain ousting king Chandrakanta Singha in 1818. At this time, the Burmese again invaded and petition to the British government was made seeking to repel the enemies but all efforts failed. A troop under the command of Robert Bruce met with a defeat in 1821. The Ahom army was totally routed and Purandar Singh fled to Gauwhati (Baruah, 1997). At the end of June 1822, Burmese commander was declared Raja of Assam.

2.1.4. End of Ahom Kingdom and advent of the rule East India Company in Jorhat

The 600 year-old rule of Ahom Kings came to an end with the infamous Burmese invasion of Assam. After the fall of Assam to the Burmese, it was decided by the British to take up arms. The Burmese was drove out of Assam and a treaty was signed between the British and the Burmese on 26th February, 1826 at a place called Yandaboo in Burma. After this treaty, known as the Treaty of Yandaboo, Assam came under the control of the East India Company. Another factor which aided this decision perhaps was the discovery in 1823 of the tea-plant in Assam and the prospects of having lands to cultivate the same were attractive to British. A last bid for Independence was made by
the Ahoms in 1830 in association with Khasis, Nagas, Singhphos, and Khamptis. British had to fight hard to win the battle. Prominent leaders Piyoli Barphukan was later hanged in Jorhat. After the Yandaboo Treaty was signed, for 12 years, Jorhat remained the capital of Upper Assam and was ruled by the families of Ahom Kings. Later on, British took over the area and the capital was shifted. In order to establish grassroot administration, a district of Sibasagar was created with Headquarter at Sibsagar town and Jorhat became a part of this district till 1983. But, soon the Rulers realized the importance of Jorhat as an administrative center and the Headquarter was shifted to the town of Jorhat from Sibasagar in 1912 (Baruah, 1997). The historic 1847 mutiny left Assam untouched, except for an attempt of conspiracy by an Ahom prince with some sepoys of Dibrugarh. It was planned by Maniram Dewan. The British banished the prince and hanged Moniram Dewan.

2.1.5. Jorhat as the Last Ahom Kingdom and last region to be colonized by the British

Jorhat was the last capital of the Ahom Kings of Assam. The capital played an important role in the development of the state, because of its location on the Cheuni Ali. Now, known as 23 National Highway 37, this road provides a road way connecting Upper Assam with lower Assam.

The Prime Minister Purnananda Boragohain played a very important role in transforming the small area into a populous town by shifting the official residence of Ahom nobles like Borgogain, Buragohain and Borpatragohains. This also resulted in the migration of skilled and professionals people to Jorhat. The criss-crossed roads show that the town was planned in such a way that no single road has to bear the entire traffic. To ensure water supply, the Desoi river which flows far to the west was diverted and made to flow to the east of the town. During the British rule, with its rich traditions,
Jorhat became a model district Headquarter. As Jorhat already had a high level of judicial traditions, and with the establishment of the Court at Jorhat it became a leader in legal knowledge and this was the foundation of a very strong and dignified Bar of that time. Most of the Govt. Departments set up their Zonal offices.

Like many other places of Upper Assam, Jorhat had also become an important town for tea. The town’s name was possibly first recorded in the context of tea in the year 1834, when Captain Jenkins, who in 1834 becomes agent to the Governor General for North Eastern Frontier at Jorhat was exploring economic possibilities of Assam. From 1853 Jorhat became a very important name when the Williamson brothers applied to the Governor for a lease of 720 acres of land at Chinnamora. The opening of Tea gardens around Jorhat town by the British tea planters led to socio-economic and sports activities in the town. Jorhat became a business town due to tea. The tea industry also played an important role in creating an academic environment in the town with the establishment of research and educational institutes (Baruah, 1997).

Assam was the last region to be colonized by the British and turned into one of their Indian Provinces. The people of Assam have had to pay the most dearly for their independence. It is true that the sun of independent Assam set at Jorhat, but a new sun rose again. It became the connoisseur of art, culture, literature, education, scientific research, music and in so many other fields.

2.1.6. Change of Administrative set up of the Town during different years

Urban development took place only from the year 1869, when Jorhat was constituted as a separate subdivision of the district of Sivasagar with Jorhat town as its sub-divisional headquarter on December 18, 1869. A Nagar Unnayan Samiti or a Town Development Committee was established in the same year to improve the sanitary condition of the town. The Committee undertook developmental works like supply of
drinking water, looking after the market places, health and sanitation etc. In the 1880s Jorhat attained the status of ‘Town’ under the Management of Jorhat Union Board, established under the Bengal Act of 1876. This followed construction of improved houses mostly owned by the trading community. The town under the Union was very small covering an area of only 0.64 sq miles. With the introduction of the Municipal Act of 1884 in Assam, the Union was abolished and Jorhat Municipal Board was established in 1909 with six wards covering an area of 4.95 sq. km. Subsequently, this great place was declared as administration head quarter of the undivided Sibsagar district in 1911, comprising of the present Sibsagar, Jorhat and Golaghat and parts of Karbi-Anglong district with Major A. Playfair as the first deputy commissioner. The modern-day district of Jorhat was created in 1983 when it was split from Sibsagar district.

Administrative set up of the Jorhat district from 1872-2011 has been extracted from the Administrative Atlas of India produced by Census of India, 2011 where the change in the same is observed. Jorhat under different administrative set up in different Census years can be seen from the table (Table-2.1) below (Chandramouli, 2011).

Table-2.1: Table showing Jorhat under different administrative set up in different Census years (1872-2011)

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Census Year</th>
<th>Jorhat under different administrative set up in Census years from 1872 to 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1872</td>
<td>Bengal Province</td>
</tr>
<tr>
<td>2</td>
<td>1881 - 1901</td>
<td>Assam Province</td>
</tr>
<tr>
<td>3</td>
<td>1911</td>
<td>Eastern Bengal and Assam</td>
</tr>
<tr>
<td>4</td>
<td>1921 to 1941</td>
<td>Assam</td>
</tr>
<tr>
<td>5</td>
<td>1951 to 1981</td>
<td>Assam</td>
</tr>
<tr>
<td>6</td>
<td>1991 to 2011</td>
<td>Assam</td>
</tr>
</tbody>
</table>

Source: Administrative Atlas of India produced by Census of India, 2011
2.2. Geographical Characteristics of the Study area

*Just as all phenomena exist in time and thus have a history, they also exist in space and have a geography*” — United States National Research Council, 1997. Any area that exists over space is an entity formed out of the characteristic feature they exhibits, either solely or in connection with one or two features. An account of these characteristic features is so essential in understanding the physical background of the study area. An account of the physical characteristics of the study area, therefore, has been detailed below in the succeeding paragraphs. The base map of the Jorhat town (Fig-2.1) and its surrounding areas is given below:

![Base map of the study area](image-url)
2.2.1. The location

Jorhat forms the administrative district of Assam, situating in the central part of Brahmaputra Valley and bounded by Lakhimpur district on north, state of Nagaland on the south, Sivasagar district on the east and Golaghat district on the west. On the North of the district, the river Brahmaputra forms the largest riverine island of the world.

The district comprises two sub-divisions viz. Jorhat and Majuli. The Jorhat sub-division is further divided into a number of circles. They are Teok, Jorhat east, Jorhat west and Titabar.

Administratively, the town and the surrounding area under study are in the Jorhat Subdivision. It is situated between 94° 7’ 34.538” E to 94° 17’ 43.87 ” E and 26° 41’ 6.887” N to 26° 49’ 38.311” N and accounts for a total of 209.19 sq. km. area consisting of about 93 villages. The entire study area falls more or less in all the revenue circles of Jorhat Subdivision. More than 55 per cent of the study area is in the Jorhat East Circle; about 38 per cent is in the Jorhat West Circle; a small portion of about 5 per cent is in the Teok Circle and about 1 per cent in the northern tip of Titabar Circle.

The town is a rapidly developing and one of the major location for business and commercial hubs of Northeast-India. The recent urban development of the town has led to its expansion to the outlying areas. With its favorable location, Jorhat has many firsts to its credit in different spheres.

- Jorhat is the first town of the Greater Assam installing electricity supply in 1923.
- The first Aeroplane on northeastern soil was landed in Jorhat in 1928.
- Jorhat Gymkhana Club is the oldest golf course in Asia and third oldest in the world.
The first stadium of Assam was built in Jorhat.

The world’s oldest and largest Tea Experimental Station is located at Jorhat.

The first non-government college of Assam J B College was established in Jorhat.

The city has many research institutes, including the world’s oldest and largest Tea Experimental Station, North East Institute of Science & Technology, Rain & Forest Research Institute, Central Muga Eri Research Institute and universities like Assam Agricultural University & Kaziranga University.

The town is growing through different phases of development to attain its present shape. The different phases of history of the town, where the Ahoms and the British played an tremendous role in transforming the city into a bustling and a well-organized entity also gives imprints of the town’s favorable location along with its physiography, climate and other factors contributing to the expansion of the town. With an illustration of these factors the physical background of the study area can be understood.

2.2.2. Physiography

Jorhat district represents mostly the plains of Brahmaputra valley at an altitude of 80-120 m above MSL. Only the southern parts of the district have low hill ranges in continuation of the Naga or Tiru hills with an altitude ranging between 150 and 450 m above MSL.

Of the total area of the study area of Jorhat town and its surrounding area (Fig-2.2), about 54 per cent comprises the vast tracts of very gently sloping plains distributed in the north east, south west and south.
In the north west, about 23 per cent of the areas are lower flood plain areas and a slight portion to the north is the active flood plain. Through the middle of the study area, a strip of gently sloping upland (dissected) covering about 23 per cent area, runs across and these are the areas where mostly tea gardens flourish.

It has been, thus, observed from the physiographical details of the study area that the congenial plain areas with the transport networks facilitated the setting up of the urban hub of Jorhat town in almost the central part of the district and its further expansion in the later period. However, the lower flood plain areas to north west and active flood plains to the north; and the portions of gently sloping upland (dissected) in the south east, east and west covering the tea gardens have restricted his expansion of the urban areas in the district.
2.2.3. Terrain

The general elevation of the district ranges from 80 to 200 m above MSL. Only, the Tiru hills in the south-eastern part of the district have elevations ranging from 120 to 200+ m above MSL having moderately to steeply sloping lands. The piedmont plains covering Mariani, Titabar and Barholla areas have elevation ranging from 100 to 120 m above MSL. The vast flood plain south of Brahmaputra around Jorhat, Teok and Titabar area have elevation ranging from 80 to 100 m above MSL. It is this terrain where 97 per cent of the study area of the Jorhat town and its surrounding area is situated. Only a narrow portion of it, of about 3 per cent, situating along the south east boundary has a terrain of elevation between 100- 120 m (Fig-2.3).

![Fig-2.3: Map showing terrain features of the study area](source: Soil Resource Atlas, Jorhat District, National Bureau of Soil Survey and land use Planning, NBSS Publication: 107, p.14)

According to SOI Toposheet No. 83 J/I the town is situated at 90m height from MSL. In the western part of the town, the Bench Mark on the NH near Gayan Gaon is
87.6 m; near Tarajan Pukhuri is 86.8 m; western bank of the Bhogdoi is 89.9 m; and near Jakaria Jan it is 92.6 m. The bench marks of the town area also showed that the river Bhogdoi is at a height about 2 m above the average height of the town.

2.2.4. Slope

A major part of the district, i.e. about 44.2 per cent of the area falls under very gently sloping class (1-3%) running across south east to the north western part through the middle of the district. The level to nearly level lands (0-1%) occupies 26.2 per cent area of the district in the north east, south west and south. The study area of Jorhat town and its surrounding area exhibit these two slopes ranges of 0-1 per cent and 1-3 per cent. While more than half of the area i.e. about 61 per cent of the area is under 0-1 per cent slope while the rest of 39 per cent of the area is under 1-3 per cent slope (Fig-2.4).
2.2.5. Geology

The entire study area as that of the most part of the district is covered by alluvium deposited by the river Brahmaputra and its tributaries. The alluvial deposits of Pleistocene period range from extensive terrace forming boulder beds to sands, silts and clays. The youngest alluvium forms the present day flood plains which support agriculture. A slightly older terrace cover extensive areas and being above the flood plains and having well drained soil, they have been used as home stead and for raising plantations of which tea is the most important. There is a narrow strip belonging to Tiru hills along the south eastern boundaries of the district. It is of sedimentary rocks belonging to Tipam groups of tertiary period consisting mainly of coarse to gritty, ferruginous sandstones and shales.

2.2.6. Soils

The soils of study area are generally coarser textured, that is, loamy sand, sandy loam and silt loam. The soils of flood plain have varying textures from loamy sand to silty clay loam. The low-lying plains around Titabar, Barhalla and Jorhat have soils with silty clay loam surface. The uplands of the plains around Mariani, Teok and Jorhat have soils with sandy loam surface. The alluvial soils of recent rivers are light grey to dark grey in colour and are confined to the flood plain area adjacent to the Brahmaputra River and its tributaries. The older alluvial soil is sandy loam to silty and clay-loam. It is light yellowish brown to light brown. The $p^H$ is 4.5 to 6.0. Being acidic in nature, these soils are suitable for tea plantation.

The soils of the district are characterized by organic matter and available phosphorus and low potash. The soils in the southern parts are residual in origin, derived from the semi-consolidated rocks underlying these areas.
2.2.7. Drainage

Jorhat district forms a part of Brahmaputra basin. It consists of principal river Brahmaputra and its 39 tributaries. The important tributaries are Jhanji, Teok, Bhogdoi and Kakodonga. Of the tributaries, Bhogdoi flows across the Jorhat town, flowing from south east to north west of the district (Fig-2.5).

![Map showing drainage of the study area](Survey%20of%20India%20Toposheet%2C%201974)

As per historical account mentioned above, the river Bhogdoi was dug by the Ahoms and made to flow through the middle of the Jorhat town. The river has its source in the foothills of the Assam-Nagaland border and it meets the plain of Assam at a place called Nagajanka. The tributaries of Bhogdoi that flow through the study area are Cheni-jan (or Ranga-jan), Tocklai-jan, Tarajan, Jakhariajan and Raroya-jan.

Further, as per historical documents Bhogdoi was known as Disoi and was a tributary of Brahmaputra. During the last two centuries Disoi (or Bhogdoi) has
undergone tremendous changes of its course due to physical and anthropogenic factors (Nath, 2012).

2.2.8. Groundwater

Ground water forms one of the major sources of water for domestic consumption in the district. This source is important from the early period of availability of domestic water in different seasons and areas.

Ground water in the district occurs under water table to semi-confined conditions in the near surface conditions and in the deeper horizon, under semi-confined to confined conditions. Depth to water level in the water table zone varies from 0.41 to 3.07 m bgl in the pre-monsoon period and 0.56 to 3.41 m bgl during post-monsoon period.

Chemical analysis of ground water carried out by Regional Chemical Laboratory of Central Ground Water Board, depicts that ground water of the district is potable except high iron content in scattered patches, which is a common factor in the ground water chemistry of the state of Assam. The content of iron varies from 0.20 to 2.36 ppm. Fluoride content in ground water in the district is found to be within 0.37 to 1.49 ppm. The variation is very much within the permissible limit. The water quality is found to be well within the permissible limit for drinking, irrigation and industrial purposes except high iron concentration in scattered patches, which can be removed through the process of aeration before use.

It can be observed from the Ground Water Prospect Map, 2008-2009 prepared by North East Space Application Centre under the Project “Rajiv Gandhi National Drinking Water Mission” by ISRO (Fig- 2.6) that ground water in about 92 per cent of the total area of the study area which comprises Jorhat town and its surrounding areas, is found under unconfined to semiconfined aquifer. Here, deeper aquifers are highly productive and casing is required. Ground water yield may vary with thickness of
alluvium. Here, iron content is beyond permissible limit as stated above, and should be removed with suitable measures.

![Groundwater Prospect Map](image)

**Fig-2.6:** Map showing ground water prospects of the study area

### 2.2.9. Climate

Climate is a critical factor in the lives and livelihoods of the people and socioeconomic development as a whole. Global climate has shown warming of 0.89 [0.69 to 1.08] °C over the period 1901–2012 which is mainly attributed to anthropogenic activities (Rathore et al., 2013).

The climate of the Jorhat district is classified as mesothermal wet climate with forest type of vegetation. The district has a moderately hot and humid climate, with minimum temperatures rarely approaching freezing during the winter months (November – February). January is the coldest month with temperature of 6.1°C. July
and August are the hottest period with average monthly temperature of about 29 °C. The average relative humidity in a year is 78.7 per cent. The mean annual rainfall in the district is 230 cm. The maximum and minimum temperatures recorded in the district are 32°C and 5°C during summer and winter respectively, while the mean temperature is recorded as 18°C. The different variables of climate, viz. rainfall and temperature have been given an account with regard to their annual and seasonal trends over a period of time in the district.

2.2.9.1. Rainfall

The region receives rainfall both during the summer and winter months from the south-west monsoon and the north-east monsoon.

The annual mean rainfall; and mean rainfall for rainy season/monsoon (April-October); and dry season (Jan/Feb/March/Nov/Dec) of the study area (Fig-2.7) for last 45 years has been observed from the records of Meteorological Observation, Toklai, Jorhat from 1970 to 2014. And it has been found that the annual mean rainfall is 1934.7 mm, rainy season mean rainfall is 1781.6 and dry season mean rainfall is 153 mm.

All the three variables of rainfall for the different seasons are showing a decreasing trendline of total annual rainfall.
<table>
<thead>
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<th>Year</th>
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<td>1994</td>
<td>250.0</td>
<td>2014</td>
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</tbody>
</table>

**Fig-2.7:** Graph showing trend of annual mean and seasonal mean (rainy and dry season) rainfall recorded at Toklai, Jorhat (1970-2014)

Further, according to *the report of the working group on Climate Change,*
(Intergovernmental Group on Tea, 21st Session, Bandung, Indonesia, 5-7 November, 2014), about 88 years of the annual total rainfall data recorded at Toklai Station of the Jorhat town, showed a decline of the same by more than 200mm (Fig-2.8).

![Graph showing yearly total rainfall (1925-2013), Toklai, Jorhat](image)

**Fig-2.8: Graph showing yearly total rainfall (1925-2013), Toklai, Jorhat**

Detailed analysis showed that there was a sudden drop in the annual rainfall after 1979 and thereafter it had never risen beyond 2299.7 mm(2011) and has even gone down to 1184.4 mm (2009). Some of the upper limits of rainfall before 1979 were 2614.8 mm (1950), 2664.0 mm (1966) and 2706.7 mm (1977) and lower limit never went below 1540.0 mm (1960)(Fig-2.8). For the last 30 years the decrease in rainfall has been at a higher rate with more abrasive trends. The years 2009 and 2010 have extreme contrasting trends. At Toklai, Jorhat the total rainfall in the year 2009 was 1184.4 mm whereas in 2010, it almost doubled to 2299.7 mm. This resulted in alternated drought and flood like situation in the region. Whereas, the declining trend of rainfall is more prominent during the recent years, i.e. post 2004.

Moreover, the pre-monsoon and post-monsoon thunder showers are very dominant over this region due to orography and the humidity available for convection. Kandalgaonkar et al., 2005 in their study to address the relationship between
thunderstorm activity and rainfall over different homogeneous regions of India also showed that over the North Eastern region the probability of association of thunderstorm with rainfall is quite high when compared to other regions (Fig- 2.9).

![Graph showing percentage occurrence of thunderstorm and rainfall over North-East India during 1951-1980](source: Assam State Action Plan on Climate Change 2012 – 2017, a Draft Report, Prepared by TER for Government of Assam.)

The draft report on Assam State Action Plan on Climate Change prepared by The Energy and Resources Institute, New Delhi also summarizes that months with high rainfall have been observed to have more number of thunderstorms. Thunderstorms in post-monsoon season have been observed to be with higher intensities than during the pre-monsoon season.

### 2.2.9.2. Temperature

The draft report on Assam State Action Plan on Climate Change prepared by The Energy and Resources Institute, New Delhi also summarizes that the 20th century has observed a warming trend of 0.51°C in India with accelerated warming observed from 1970 onwards. The region has experienced increase in the annual mean maximum temperatures, with increase at the rate of +0.11°C per decade and annual mean temperatures at a rate of 0.04°C per decade. An analysis of the different variables of
temperature viz. maximum mean and minimum mean temperatures from 1970 to 2014 has been made differently for 3 phases, viz. (a) the entire year; (b) rainy season/monsoon (April to October); and (c) dry season/pre-post monsoon (November-March).

![Graphs showing temperature trends](image)

**Fig-2.10:** Graph showing trend of annual maximum mean and seasonal maximum mean (rainy and dry season) temperature recorded at Toklai, Jorhat (1970-2014)
It has been found that annual maximum mean, summer maximum mean and winter maximum mean temperatures are 28.16\(^0\) C; 30.59\(^0\) C; and 24.75\(^0\) respectively. And over the 45 years i.e. from 1970 – 2014, while no distinct trend has been observed in both the annual and seasonal maximum temperatures, but it showed a gradual rise and remained above ideal in the region (Fig-2.10).

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<thead>
<tr>
<th>Minimum Temperature, Toklai, Jorhat (1970 to 2014)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Annual Minimum Mean (Jan-Dec)</strong></td>
</tr>
<tr>
<td><strong>Mean Minimum Temperature, April-October</strong></td>
</tr>
<tr>
<td><strong>Mean Minimum Temperature, Jan/ Feb/ Mar/ Nov/ Dec</strong></td>
</tr>
</tbody>
</table>

Minimum Temperature Data, 1970-2014 has been collected from Toklai, Jorhat.

Fig-2.11: Graph showing trend of annual minimum mean and seasonal minimum mean (rainy and dry season) temperature recorded at Toklai, Jorhat (1970-2014)
Likewise, the annual minimum mean temperature is 19.09\(^0\) C; for the summer season, it is 23.36\(^0\) C; and for the winter season, it is 13.12\(^0\) C (Fig-2.11).

Now, from the report of the working group on Climate Change, (Intergovernmental Group on Tea, 21\(^{st}\) Session, Bandung, Indonesia, 5-7 November, 2014), it has been observed that the trend over a much longer period, i.e. over about 88 (1925-2013) years, a significant increase in the minimum temperature has been observed at Tocklai, Jorhat. There is more than 1.4\(^\circ\)C increase in minimum temperature (Fig – 2.12).

Fig-2.12: Yearly average minimum temperature at Toklai, Jorhat (1925-2013)

Fig-2.13: Total number of days having > 35\(^{\circ}\)C temperature (1924-2013), at Toklai, Jorhat
Moreover the number of days having temperature $> 30^0\text{C}$ or even $35^0\text{C}$ is generally increasing with the increase in minimum temperature (Fig – 2.13).

![Total No. of Days ≤ 6°C : 1924-2013 : Toklai, Jorhat](image)

*Fig-2.14: Total number of days having $\leq 6^\circ\text{C}$ temperature (1924-2013), at Toklai, Jorhat*

Further analysis of the extreme events shows that the number of days having temperature less than or equal to $6^0\text{C}$ and $8^0\text{C}$ have decreased recently (last 30 decades) (Fig-2.14), which indicates that the minimum temperature is increasing and more number of days are with higher minimum temperature compared to earlier years, indicating a warmer trend.

**2.2.9.3. Impacts of recent variations in the climatic variables in the study area**

From the above account of the different climatic variables of the district as well as Toklai, Jorhat, it has been found that the study area has experienced recent variations of the same. Among the variables of climate that have been detailed above, it has been found that the recent time has experienced extreme events of rainfall. However, the trend that has been observed in rainfall is a slow decreasing one. And this declining trend of rainfall is more prominent during the recent years, i.e. post 2004. The months with high rainfall have been observed to have more number of thunderstorms.
Thunderstorms in post-monsoon season have been observed to be with higher intensities than during the pre-monsoon season. Though no distinct trend has been observed in both the annual and seasonal maximum temperature, it remained above ideal in the region. However, the trend of minimum temperature over a much longer period, i.e. over about 90 years showed a significantly increasing trend. The observed trends of the different climatic variables in the district are as follows (Table-2.2):

Table-2.2: Table showing trends of climatic variables in Jorhat

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Precipitation</td>
<td>Annual (Jan-Dec)</td>
<td>2125.85 mm</td>
<td>Declining</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rainy Season (April-Oct)</td>
<td>1959.45 mm</td>
<td>Decreasing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dry Season (Jan/Feb/March/Nov/Dec)</td>
<td>166.39 mm</td>
<td>No Change</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Annual (Jan-Dec)</td>
<td>1934.7 mm</td>
<td>Decreasing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rainy Season (April-October)</td>
<td>1781.6 mm</td>
<td>Decreasing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dry Season (Jan/Feb/March/Nov/Dec)</td>
<td>153 mm</td>
<td>Decreasing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>Annual Rainfall</td>
<td>decline of annual rainfall by more than 200 mm</td>
<td>Decreasing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maximum Temperature</td>
<td>District (1901-2001)</td>
<td>Annual (Jan-Dec) 27.72°C</td>
<td>Increasing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Summer (April-October)</td>
<td>29.80 °C</td>
<td>Increasing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Winter (Jan/Feb/Mar/Nov/Dec)</td>
<td>24.81 °C</td>
<td>Increasing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jorhat Town, Toklai (1970-2014)</td>
<td>Annual (Jan-Dec) 28.16°C</td>
<td>Gradual rise</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Summer (April-October)</td>
<td>30.59°C</td>
<td>Gradual rise</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Winter (Jan/Feb/Mar/Nov/Dec)</td>
<td>24.75°C</td>
<td>Gradual rise</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum Temperature</td>
<td>District (1901-2001)</td>
<td>Annual (Jan-Dec) 13.02 °C</td>
<td>Increasing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Summer (April-October)</td>
<td>21.96 °C</td>
<td>Increasing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Winter (Jan/Feb/Mar/Nov/Dec)</td>
<td>13.02 °C</td>
<td>Increasing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jorhat Town, Toklai (1970-2014)</td>
<td>Annual (Jan-Dec) 19.09°C</td>
<td>Steady (Insignificant Change)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Summer (April-October)</td>
<td>23.36 °C</td>
<td>Steady (Insignificant Change)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Winter (Jan/Feb/March/Nov/Dec)</td>
<td>13.12 °C</td>
<td>Steady (Insignificant Change)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Jorhat Town, Toklai (1925-2013)</td>
<td>Annual Minimum Temperature there is more than 1.4°C increase</td>
<td>Significant increase</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of days having temperature &gt; 30°C or even 35°C (1925-2013)</td>
<td></td>
<td></td>
<td>Increasing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of days having temperature less than or equal to 6°C and 8°C (1925-2013)</td>
<td></td>
<td></td>
<td>Decreasing</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Climatic Data has been taken from the website of India Water Portal: http://www.indiawaterportal.org/metdata and Toklai Experimental Station, Jorhat Town.
Stapleton, S, 2013 also, working in the context of the city of Jorhat made few projections stating that by the end of the 2020s, both minimum and maximum temperatures are likely to increase in most seasons along with the heat waves. The major concern, that was cited, is that the current land-use development patterns and urbanization processes, coupled with changes in the climatic variables, will increase the city’s risk of suffering greater harm during future climate hazard events.

Moreover, the summarized projection of likely changes in the climate for the state of Assam for 2030s as derived from the report on “Assam State Action Plan on Climate Change” prepared by The Energy and Resources Institute, New Delhi, it has been concluded that an increase in the rainfall in the pre-monsoon and post-monsoon months might be associated with increased number of thunderstorms in the region. Changes in rainfall patterns and its increasing variability in the future may have some regions experiencing scarcity of rainfall and others an increase. Drought like conditions might prevail given the climatic variations expected. Projected increase in rainfall, rainfall intensities and accelerated summer flows may produce more frequent conditions of floods, flash floods in the Brahmaputra valley. Changes in extreme events of rainfall and temperature might have direct or indirect impacts on different sectors in the region.

The concern here is that, with the ever increasing land use changes and development trends in the small towns like that of the study area of Jorhat Town and its surrounding areas, impacts of these variations poses additional challenges. The increase in temperatures and variability of intense precipitation impacts the living space as well as the life of the growing population in the form numerous threats viz. water logging and flooding, heat island, pollution, and scarcity in drinking water and so on. Changing weather patterns and rising temperatures leaves towns like Jorhat to reel under the
threats of climate change and without having the capacity to cope up with the changes in the climate.

2.2.10. Natural Vegetation

Due to the topographical as well as climatic characteristics of the district, the vegetation of the area represents subtropical and monsoonal vegetation characterized by mixed deciduous and grassland type of vegetation. (Sharma, 2010).

As appeared from the map below obtained from North East Space Application Centre (NESAC), it is evident that not much of the land of the district is devoted as far as natural vegetation is concerned. While mixed moist deciduous and bamboo are found in the hilly stretches in the south eastern hills, the entire district is covered by agricultural land comprising of the croplands and plantations.

![Map showing vegetation type in the study area](source)

If we look into the study area of Jorhat town and its surrounding areas, as can be seen in the map (Fig-2.15), the entire area is predominantly an agricultural land
comprising of the croplands and plantations and with scattered tracts of orchards or the household plantations. The common species that are found in the household plantation are mango, jackfruit, coconut, guava, jamu, panial, amlokhi, arecanut and various species of bamboos.

2.2.11. Socio-economic characteristics of the study area

The socio-economic characteristics of the study areas throw significant light on the problem under study. The main socio-economic characteristics that have been given an account here for getting a comprehensive picture of the underlying factors of the problem under study are population, its density, composition and age—sex; economic characteristics of the people; literacy; household size and pattern; transport and communication; facilities of lightning and drinking water. The following paragraphs give brief account of these characteristics.

2.2.11.1. Population

To get the population scenario of the study area under research, it is essential to have the picture of the population scenario of the district as a whole.

It has been observed that Jorhat shared about 3.7 per cent of the total population of the state of Assam with a population number of 10,92,256 according to the 2011 census. Further, the decadal variation of the district with respect to that of the state has been observed from 1901 to 2011 and it has been found that both are showing a declining trend (Fig-2.16).
Now, looking at the population scenario of the study area which comprises the Jorhat town and its surrounding areas, it has been found that, it covers 27.52 percent of the total population of the district. The study area which shares only 7.34 per cent of the total area of the district is providing accommodation to 29.29 per cent of the total households of the district (Fig-2.17).

It has been observed from the decadal variation of population from 1991 to 2011 that the study area also showed a declining trend corresponding to that of the state and the district trend. From 1991 to 2001, population in the study area increased by 24.21 per cent but it recorded only 10.93 per cent increase in 2011(Fig-2.18).
2.3.11.1. Density of Population

The population density of the district is 383 persons per sq km in 2011, which is marginally lower than the average density of the state (398 person per sq. km) of Assam. In the study area of Jorhat town and its surrounding areas, population density has been found to be very high. In the year 1991, it was 1041 persons per sq. km and it increased to 1437 in 2011(Fig-2.19).

2.3.11.1.2. Composition of Population

While looking at the composition of the population of the district as a whole, it has been found that Hindus forms the largest group followed by Muslims and Christians.
The caste composition showed that schedule tribe population is more than that of schedule caste population. As published in the Basic Data Sheet by Census of India of 2001, the largest three groups of schedule caste population are the Kaibartta, Brittial Bania and Generic caste. And the largest three schedule tribe groups are the Miri, Kachari and Boro.

Contrary to the district profile, the population composition in the study area of the Jorhat town and its surrounding area exhibited a picture with a higher percentage of schedule caste population comprising of 6.95 per cent and schedule tribe population covering only about 2.76 per cent.

2.3.11.3. Age-Sex Composition

In 2001, the district exhibited a slightly higher sex ratio i.e. 933 females per 1000 males than that of the state which is 932. In 2011, the sex-ratio again showed a rise with 962 females per 1000 males as compared to that of the State, i.e. 958 females per 1000 males. The sex composition in the study area of Jorhat town and its surrounding area exhibited that the total percentage of female population is slightly less (49.02) than that of the male population (50.98 per cent). However, the percentage of female population is higher (49.18) in the rural areas than that of the urban areas (48.38 per cent).

Observing the age-composition, it has been found that about 11.41 percent of the population is under the age group of 0-6 years. In rural areas the percentage is found to be little higher (11.86 per cent) than that of the urban areas, where it is 9.61 per cent.

2.2.11.2. Literacy

Jorhat has the honor of having the largest number of educated people among all districts of Assam (Hazarika, 2011). About 73 per cent of the total populations of the district are literate. The literacy rate in the urban area recorded a higher rate than that of the rural areas.
The study area, which shares about 7.34 per cent of the total district area, covers about 22.27 per cent of the total literate population of the district. Of the total population, literate population accounted for 80.91 per cent in the study area. Looking into the sex composition of the literate population; it has been found that male literacy accounted for 53.20 per cent, which is higher than that of the female literacy of 46.80 per cent. However, out of the total population of the study area, illiterate population comprised of 19.42 per cent where female illiterate (56.21 per cent) are higher than that of the male illiterates (43.79 per cent).

2.2.11.3. Household size and pattern

It has been found that the study area shared 29.29 per cent of the total households of the district in 2011.

![Percentage of different household sizes in the Jorhat town and its surrounding areas, 2011](Source of Data: Census of India, 2011)

Fig-2.20: Percentage of different households in the Jorhat town and its surrounding areas, 2011

It has been observed that 57 per cent of the households have family size of 1-4 persons giving a picture of the a broad category of nuclear families especially in the urban hub of the study area. However, 43 per cent of the households exhibited family size with 5 to more than 9 persons giving an impression of presence of a large number of joint families in the study area (Fig – 2.20).
Condition of material of roof, wall and floor

a) Roof: Looking into the pattern of housing in the study area comprising of the Jorhat town and its surrounding areas, it has been revealed by the census data that the roof material of 94.28 per cent houses, especially in the Municipality area and its adjoining areas, are made up of G.I./metal/asbestos sheets. There are also houses whose roofs are made up of grass/thatch/bamboo (3.34 per cent); stone/slate (1.23 per cent); handmade tiles (0.71 per cent), and roofs of few houses of about 0.44 per cent are made up of burnt bricks; plastic/polythene; and machine made tiles (Fig-2.21).

![Roof Pattern of houses in the Jorhat Town and its surrounding areas, 2011](image)

Source of Data: Census of India, 2011.

Fig-2.21: Roof pattern of the households in the Jorhat town and its surrounding areas, 2011

b) Wall: Likewise, about 42.77 per cent houses in the study area are made up of burnt brick/stone packed with mortar and concrete. Although a good percentage of about 51.53 per cent of houses are made up of with grass/thatch/bamboo wall. Moreover 5.68 per cent houses in the study area are also found to be made up of mud/unburnt brick; stone not packed with mortar; plastic/polythene; wood and G.I./metal/asbestos sheets (Fig-2.22).
c) **Floor:** About 80.19 per cent houses, especially in the Municipality area and its adjoining areas are found to be with concrete floors. But taken together in the study area, it has been observed that 35.27 per cent of the houses in the study are floored with materials like cement; mosaic/floor tiles; burnt bricks and stones while 64.56 per cent of them are found to be made up of mud. Few houses of about 0.17 per cent are found to be of wooden and bamboo floors (Fig-2.23).
2.2.11.4. Economic Characteristics

As per Census of India, 2011, the economic characteristics of the people in the study area exhibited 40.19 per cent of total working population which is little lower than that of the district i.e. 45.65 per cent. Non-working population of the study area is 59.81 per cent which little higher than that of the district i.e. 54.35 per cent.

Table-2.3: Table showing economic characteristics of the people in the Study Area in comparison to the district, 2011.

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Proportions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Study Area</td>
</tr>
<tr>
<td></td>
<td>(Jorhat Town and surrounding areas)</td>
</tr>
<tr>
<td>Total Worker Population Person</td>
<td>40.19</td>
</tr>
<tr>
<td>Non-Working Population Person</td>
<td>59.81</td>
</tr>
<tr>
<td></td>
<td><strong>100.00</strong></td>
</tr>
<tr>
<td>Main Working Population Person</td>
<td>77.21</td>
</tr>
<tr>
<td>Marginal Worker Population Person</td>
<td>22.79</td>
</tr>
<tr>
<td></td>
<td><strong>100.00</strong></td>
</tr>
<tr>
<td>Main Cultivator Population Person</td>
<td>5.75</td>
</tr>
<tr>
<td>Main Agricultural Labourers Population Person</td>
<td>3.63</td>
</tr>
<tr>
<td>Main Household Industries Population Person</td>
<td>4.51</td>
</tr>
<tr>
<td>Main Other Workers Population Person</td>
<td>86.11</td>
</tr>
<tr>
<td></td>
<td><strong>100.00</strong></td>
</tr>
<tr>
<td>Marginal Cultivator Population Person</td>
<td>12.20</td>
</tr>
<tr>
<td>Marginal Agriculture Labourers Population Person</td>
<td>12.07</td>
</tr>
<tr>
<td>Marginal Household Industries Population Person</td>
<td>12.87</td>
</tr>
<tr>
<td>Marginal Other Workers Population Person</td>
<td>62.86</td>
</tr>
<tr>
<td></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

Source of Data: Census of India, 2011.

Further, of the total working population main working population comprises about 67.90 per cent whereas marginal working population covers about 32.09 percent.

The composition scenario of the total main working population showed that the highest proportion is covered by the other workers which are about 86.11 per cent. This is followed by the proportions of cultivators (5.75 per cent), household industries (4.51 per cent) and the lowest proportion of agricultural laborers (3.63 per cent).
The trend of proportions of the marginal working population shows that it is highest in case of other workers (62.86 per cent) and recorded more or less similar proportions in case of its household industries (12.87 per cent); cultivator (12.20 per cent) and agriculture labourers (12.07 per cent).

While making a comparison of the economic characteristics of the people in the study area and that of the district, striking differences have been observed in their proportions of the other workers and cultivators of the main working as well as marginal working population.

While, with regard to the main working population, the proportion of other workers and cultivators are 86.11 per cent and 5.75 per cent respectively in the study area, they are 60.64 per cent and 29.14 per cent in the district level. This difference is quite high in case of the other workers in the marginal working population also, which is 62.86 per cent in the study area and 39.18 per cent in the district. These differences are mainly attributed to the fact that the study area comprises the Jorhat town, the major urban hub of the district, and its surrounding areas with more or less the characteristics of an urban area. This is the area where people are basically involved in trade, commerce, business, transport, banking, construction, factory etc. apart from services of government organizations, municipality, educational institute, entertainment and so on.

2.2.11.5. Transport and Communication

Jorhat town is well connected to the other parts of the state through road and railway network besides having an airport at Rowriah and a port at Nimatighat with daily ferry connections to Majuli, the riverine island on the Brahmaputra. The surrounding rural areas are also linked with the town through motorable roads. The Ahom kings laid the foundations of this town by constructing broad roads, and dug a number of tanks (Pukhuri’s) for supply of water. The discovery of the tea plant in 1823
led to the establishment of Tocklai, the tea experimental station at Jorhat for tea research. The good network of transport in the town facilitated growth of a number of educational institutions viz. schools, colleges, and universities and research institutes. This gradually, led to the growth of the town as an important urban Centre in Upper Assam.

In the Jorhat town area, Assam Trunk Road (A.T.Road) and Gar Ali forms the two main roads carrying out the highest volume of traffic. The A.T. Road passes through the town in the east-west direction and divides the town into two halves. A by pass - NH 37 was constructed and opened in 1995 to share a major part of the traffic. The other important roads of the Jorhat Municipality area are K.B.Road; J.B.Road; Na Ali; Fancy Ali; SeuniAli; and Malow Ali. These roads are criss-crossed over the entire region. According to Johat Municipality Board, Jorhat the total road length within the Municipal limit is 87 km out of which 39 km is Municipal Road and the rest 48 km is PWD Road. Up till now Jorhat Municipal Board has paved 11 km of road and balance is remaining unpaved.

2.2.11.6. Source of lighting

In the Jorhat town and its surrounding areas, the major source of lighting is electricity covering a total of 68.12 per cent households, followed by kerosene which covers a total of 31.20 per cent households (Fig-2.24). And a small portion of about 0.20 per cent households get lighting from solar energy. It has been found that 0.38 per cent household does not have any lighting facility at all.
2.3.7. Drinking Water

It has been found that the general sources of drinking water in the district are tap water from treated source; tap water from un-treated source; covered well; un-covered well; hand pump; tubewell /borehole; spring; river/canal; and tank/pond/lake etc. So, the two major sources of water for domestic consumption are surface water and ground water. Both the sources are important from the early period of availability of domestic water in different seasons and areas. In the Jorhat Town, supply of drinking water has been managed by four organizations, viz., Jorhat Municipal Board, Assam Urban Water Supply and Sewerage Board, Jorhat, Swajaldhara Scheme and Marwari Thakurbari Scheme. Jorhat Municipal Board has been providing water supply to its consumers since 1951 through the four water treatment plants situated at Bhogdoi, Macharhat, Nehru Park and Sonari Gaon. While Bhodoi water supply project is the only one whose source is the river itself, the other four depends on ground water source as all of them are situated far from the river hence depends on groundwater. While the Assam Urban Water Supply and Sewerage Board has been providing drinking water since 1998 from both the sources of Bhogdoi river and groundwater, the Swajaldhara Scheme and
Marwari Thakurbari scheme are depending only on ground water since the plants were started from 2007, and 1970 respectively. Apart from these water supply projects, there are about 250 street hydrants located in different wards of Jorhat town. The distribution lines connected with each of the schemes are very old and due to other development activities of the town, viz. development and widening of the roads, construction of roads, drains and footpaths etc., there are plenty of many breakages and leakages in the lines (Bhuyan et al., 2013). However, Census of India, 2011 showed that majority of the households i.e. about 33.95 per cent depend on hand pumps. Households depending on tubewell/ borewell are 16.45 per cent; tank/pond is 12.09 percent; uncovered wells are 3.58 per cent; and tapwater from untreated sources is 2.71 per cent. Only 0.88 per cent of the household uses cover on the wells. And there are few percentage of households, of about 2.05 per cent who still depend on river/canal, spring and other sources. It has been found that only 28.27 per cent of the households depend on tapwater from treated sources revealing the fact that the supply of drinking water is not sufficient in the study area which covers the most important urban area of the district (Fig-2.25).

![Graph showing percentage of households with different sources of drinking water in Jorhat town and its surrounding areas, 2011]

**Fig-2.25:** Percentage of households with different sources of drinking water in the Jorhat town and its surrounding areas, 2011
Looking into the location of the sources of drinking water as per census of India, 2011, it has been found that nearly half (48.55 per cent) of the households in the study area have their sources of drinking water within their premises. 34.55 per cent have drinking water sources outside their premises. However, 16.90 per cent of the households have the drinking water sources away from their premises (Fig-2.26).

![Location of Drinking Water Source in the Study Area of Jorhat Town and Its Surrounding Areas, 2011](image)

*Fig-2.26: Location of drinking water sources in the Jorhat town and its surrounding areas, 2011*

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