

ENVISAGING THE PERI-URBAN LANDSCAPE OF JORHAT, ASSAM

Submitted

*In partial fulfilment of the requirements for
the award of the degree of*

**MASTER OF ARCHITECTURE
(LANDSCAPE)**

By

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Declaration

I, Anupama Sharma, Scholar No.2017MLA007 hereby declare that the thesis entitled Envisaging the Peri-Urban Landscape of Jorhat, Assam, submitted by me in partial fulfilment for the award of Master of Architecture (Landscape), in School of Planning and Architecture Bhopal, India, is a record of bonafide work carried out by me. The matter embodied in this thesis has not been submitted to any other University or Institute for the award of any degree or diploma.

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Anupama Sharma

Certificate

This is to certify that the declaration of Anupama Sharma is true to the best of our knowledge and that the student has worked under the guidance of the following panel.

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1 Introduction

1.1 Background

“Urbanisation is a form of metropolitan growth that is a response to often less understood implications of technological, economic, social, and political forces and to the physical geography of an area.” (CES (IISc), n.d.) The migration from rural to urban areas in search of better opportunities for jobs, healthcare, education, sanitation, etc. leads to increase in population in urban areas.

The urban population in the world is expected to grow from 54% of the 7.3 billion people in 2015 to 66% in 2050.

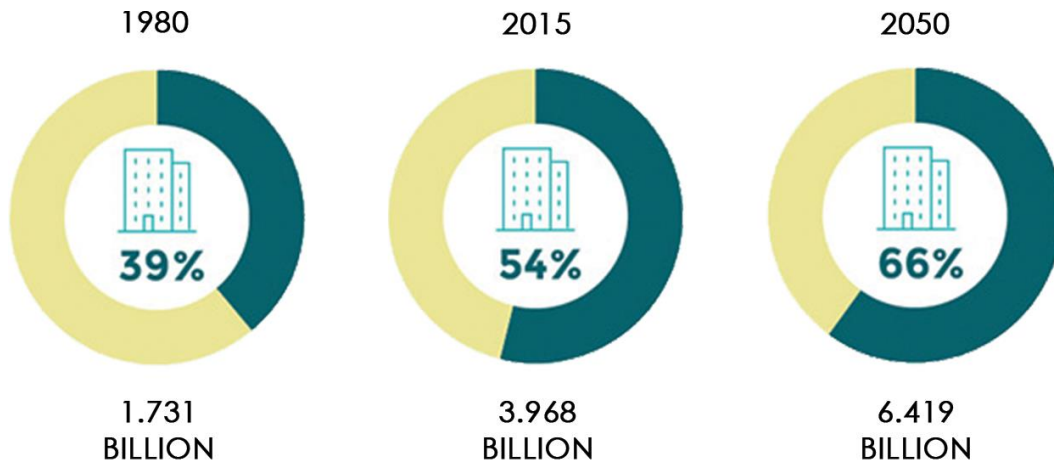


Figure 1: Share of Population Source: www.urbanet.info

1.1.1 What is urban sprawl?

“Urban sprawl is the outgrowth of the urban areas caused by the uncontrolled and uncoordinated urban growth along the periphery of the cities, along highways, and along the road connecting a city.” (CES (IISc), n.d.) The ribbon development along the highway, the unplanned growth in certain pockets of the exterior areas of the city leading to the change in land use.

The threaten land is vital for not only wildlife but also agriculture and mitigation of carbon dioxide emissions.

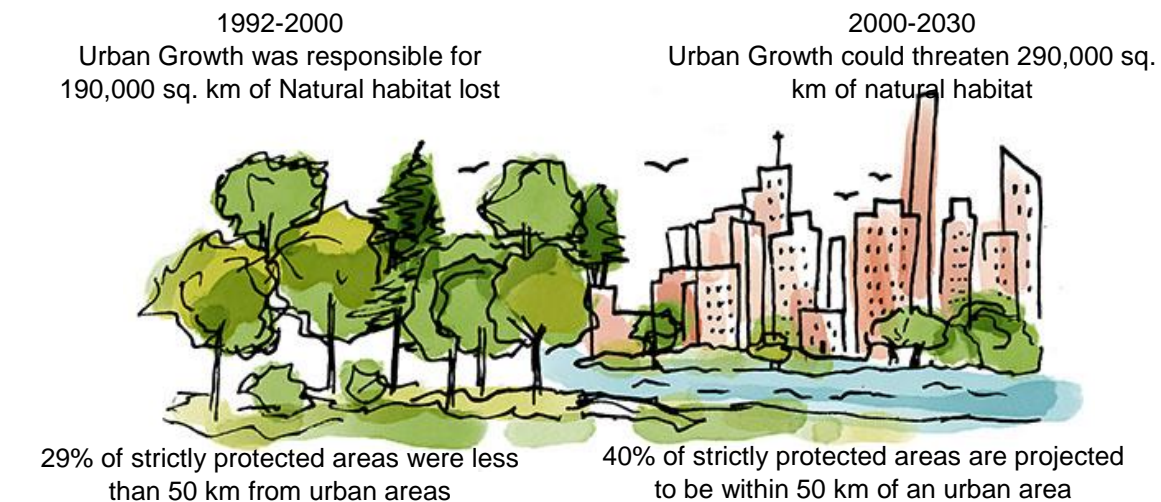


Figure 2: Natural Habitat Loss Source: (The Nature Conservancy, 2018)

1.1.2 What is urban fringe?

Urban fringe is the area of transition between two different distinct land use patterns. In planning term, it is used to describe the suburban area between the city and rural area. The sprawl results in the engulfing of villages into peri-urban areas, peri-urban areas to towns and towns into cities. In majority of the cases due to lack of prior planning, coordinated decision-making and visualization of the outgrowths, these areas are devoid of basic amenities like water, electricity, sanitation, etc. and also results in inefficient and drastic change in land use affecting the ecosystem and thus threatening the sustainable development of the region.

The urban fringe has the characteristics of both urban as well as rural area, thus is a place of importance. There is no definite growth pattern of the city into the outskirts. It sprawls haphazardly, making rapid advances at one point, and hardly moving at all at another. This results into incoherent landscape which is the characteristics of the fringe.

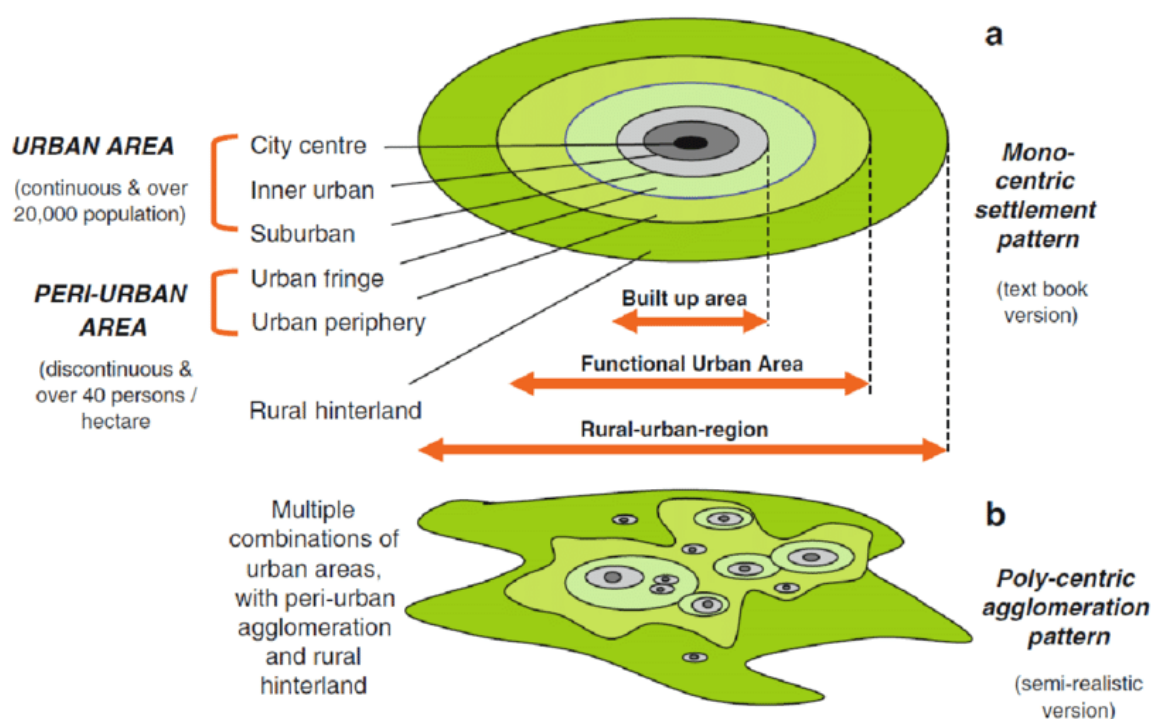


Figure 3: Concept of Peri-Urban areas and the Rural-Urban Fringe Source: (Piotr IDCZAK, 2018)

1.1.3 The spatial extent of urban fringe

The extent of rural urban fringe actually depends upon intensive fieldwork from village-to-village around a limit of nearly 10 to 15 kilometres from the central city limits.

- (i) For about two kilometres around the central-city limits, the first ring of the fringe may develop. It contains small towns and urbanized villages.
- (ii) The next level of the fringe area includes non-municipal towns and urbanized villages, extends further for a distance of five kilometres or more around the previous one.

(iii) The third category forming the outer zone includes the villages having little or no urban land uses, linked with the city by their allied functions.

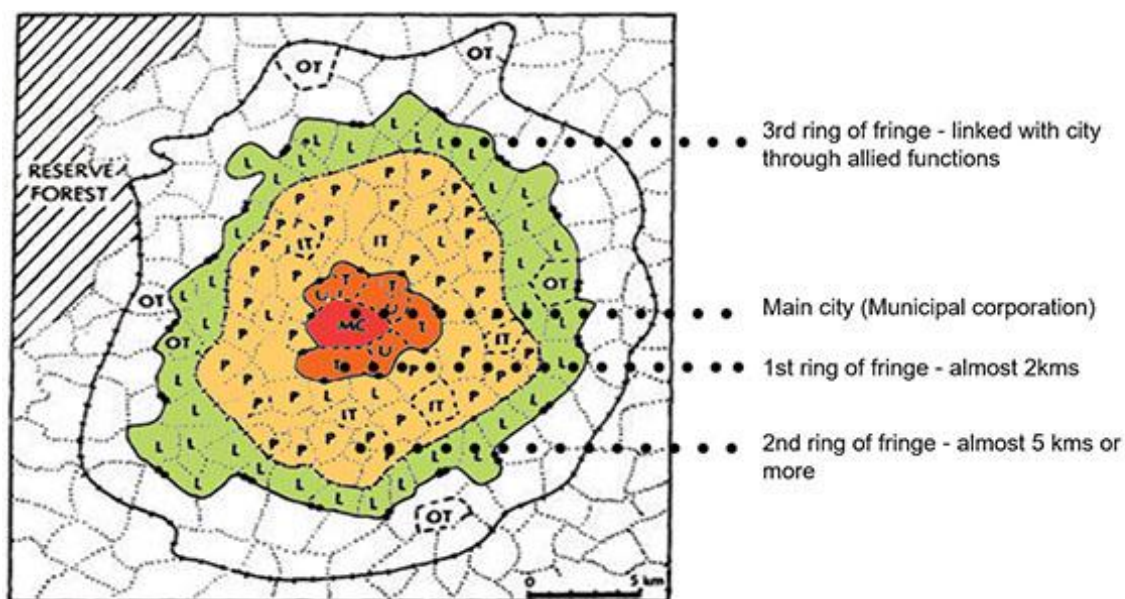


Figure 4: Spatial extent of rural-urban fringe Source: (Sharma, n.d.)

1.1.4 Benefits of Rural-Urban fringe

The peri-urban area has the benefits of both urban areas and rural areas

- Land prices- The land is cheaper as this area has lower accessibility to that of the inner city areas and fewer people are willing to commute daily to the inner city.
- The traffic congestion is less due to less population, thus less number of vehicles.
- The pollution is comparatively less due to less hampered natural areas which helps in carbon sequestration.
- There is easier access and a better road infrastructure – as it is a newer development with a lot of space available.
- The peri-urban areas helps in environmental benefits such as reducing urban heat, recycling grey water and managing the storm water management, providing natural habitat.
- The social benefits are related to the social activities associated to the area such as agriculture which provides food security, any traditional art such as handlooms, which provides cultural identity to the areas, the traditional architectural style, etc.

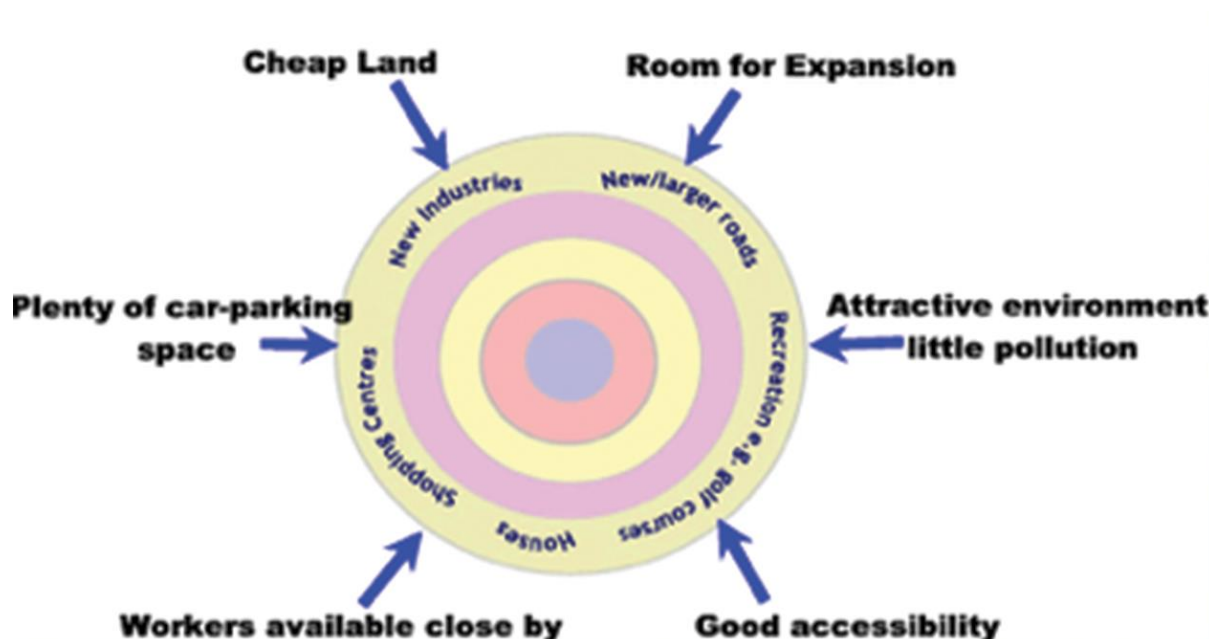


Figure 5: Benefits of the Rural-Urban Fringe Source: (Planning Tank, n.d.)

Fig: Benefits of the rural-urban fringe for economic developments

Source: <http://igeogers.weebly.com>

1.1.5 Issues

The peri-urban area has various issues and above that it places stress on the infrastructure of the city such as the facilities of water, sanitation, open spaces, transportation, etc.

- The environmental degradation which occurs due to the unplanned planning such as loss of habitat, deforestation, pollution in the natural streams.
- Lack of proper amenities and facilities like healthcare, sanitation, roads and infrastructure, parks, etc.
- Growth of unplanned and squatter settlements.
- Loss of the agricultural lands in the uncontrolled development.



Figure 6: Loss of Habitat



Figure 7: Landfill in the outskirts of Noida

1.2 What is the role of a Landscape Architect?

We already know that there will be growth, and this time we can be prepared. To change the face of the developing cities, it requires an integrated approach. In India, landscape is unrecognised in multi-level governance. Master plan or development plans are carried out the planners. Many times the solutions planning ignore, overlooks the landscape functions that disturb the natural processes and harm in irreversible ways.

So, as landscape architects we must understand our role and use expertise in designing better cities for the coming generation, future cities. Landscape architects not just satisfy the aesthetic requirements by designing gardens, parks but play a major role in the planning of a city. Play an important role in maintaining the biodiversity of a city by incorporating nature in the design and planning. The presence of wildlife in urban areas can enhance human quality of life. Individuals are more likely to live longer (Donovan et al. 2013). Improve the resilience of cities to climate change, potentially cooling cities by up to 8 °C in summer.



Figure 8: Nature dependency of the future cities Source: (Bekessy, 2016)

2 Site and Project Introduction

2.1 Site location

Jorhat, a fast growing city in Assam, lies on the flat plain of the river mighty Brahmaputra which flows east to west about 8 kilometres north of the town. Jorhat district has three sub divisions- the head quarter of Jorhat town, Titabor and Majuli. With the change of time there came tremendous change in the urban scenario of the Jorhat Town. The town today has evolved to be one of the major commercial and business hubs of the state.



Figure 9: India with location of Assam Figure 10: Assam with Jorhat district location

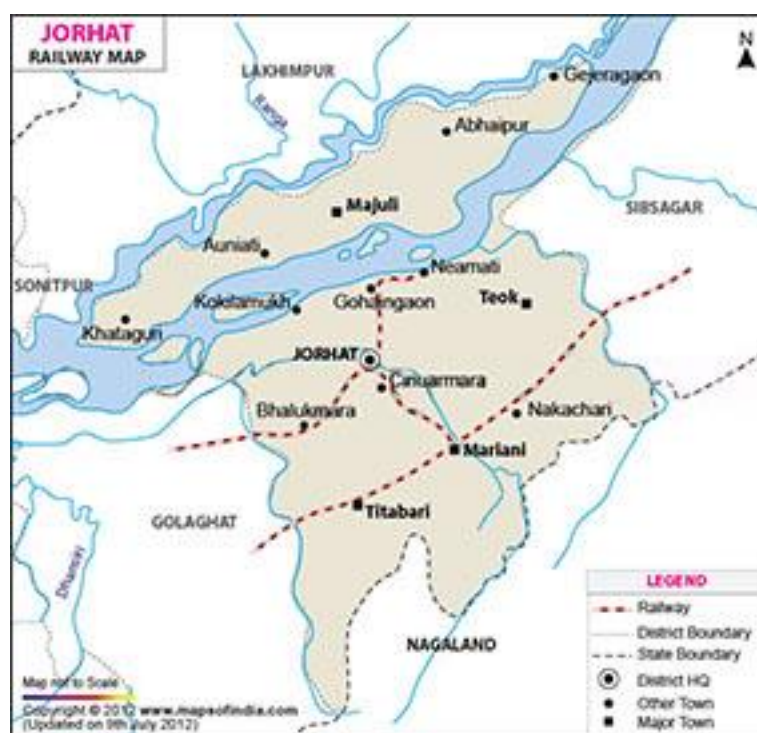


Figure 11: Jorhat District Source: (Maps of India, 2013)

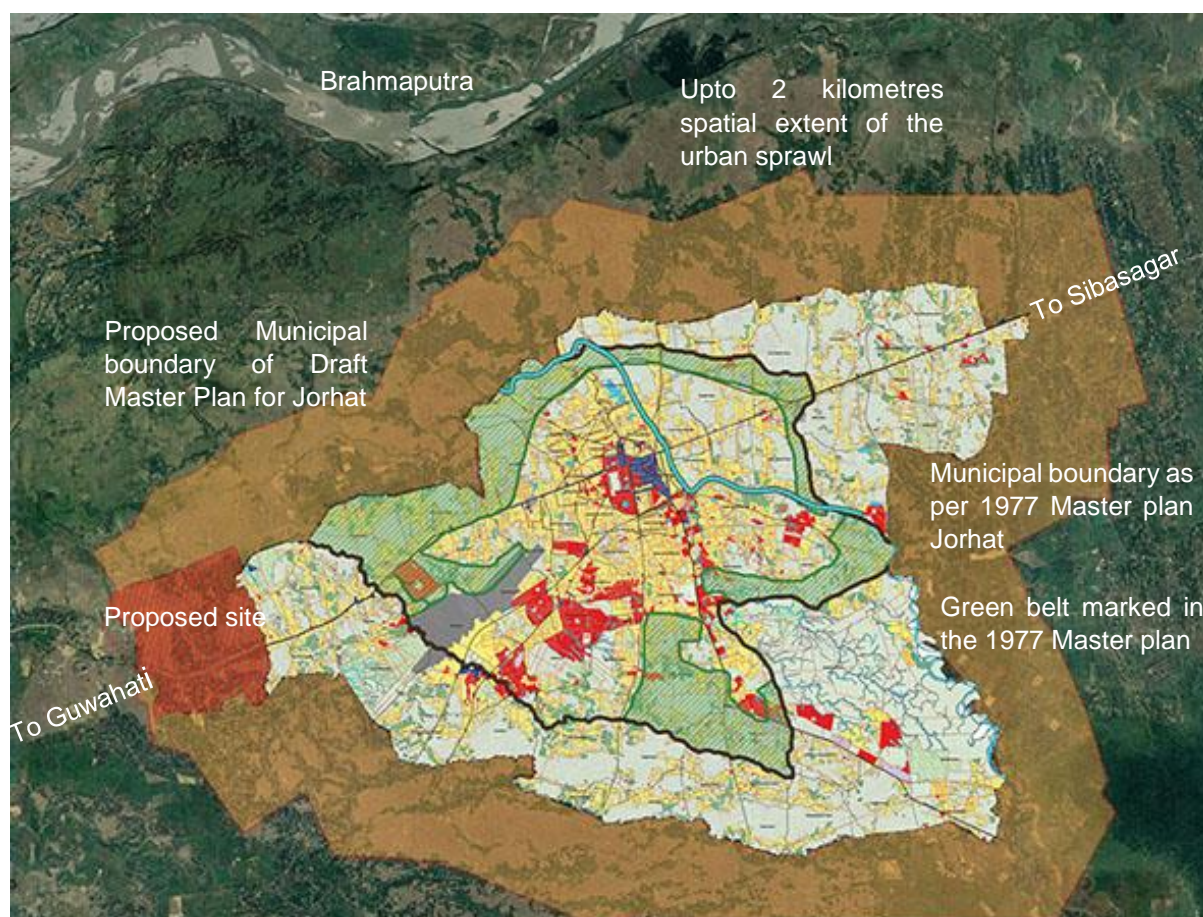


Figure 12: Existing landuse plan 2015 overlap with the Google Earth image of Jorhat
Source: J. J. Bora, Deputy Director, Town & Country Planning, Jorhat, Assam and Google earth

The municipality board area has increased by nearly 2 times while the population has increased by 25 times. This results the load in terms of housing, economic activities, traffic and so on. The first master plan of the district with an area of 50 sq.km. was prepared in 1978 through a thorough survey by Town and Country Planning Department but it has not been implemented at all and expired in 1991. In absence of the Master Plan which provides guidelines in carrying out the developmental activities, the township has crossed its earlier demarcation and merged into the countryside adjacent to its outskirts into a sprawling effect.

The site demarcation is done with the Municipal boundary on eastern and the watershed boundary on the western. The northern side has a road and the southern side has a water stream enclosing the site. The A. T. Road, NH 37 passes through the site. Out of all the potential spatial extent the western side is selected due to the rapid growth towards the highway which goes to Guwahati. The highway extension from 4 lane to 6 lane under has resulted in ribbon development along it. This area is anticipated to grow the fastest.

2.2 History and cultural activities of Jorhat

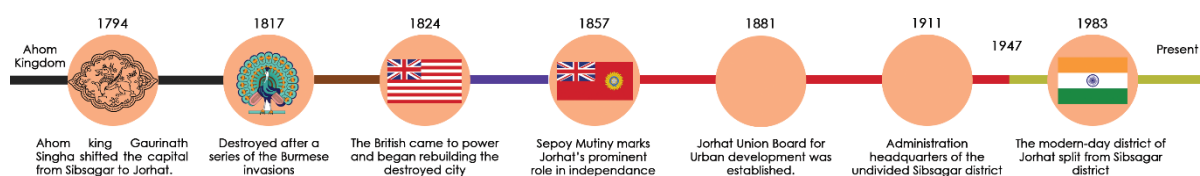


Figure 13: Timeline of Jorhat administration

"Jorhat" or "Jorehaut" means two haats or mandis- "Macharhat" and "Chowkihat" which existed on the two different banks of the river Bhugdoi during the 18th century. Jorhat was the last capital of the Ahom Kingdom. In 1794 the Ahom king Gaurinath Singha shifted the capital from Sibsagar (erstwhile "Rangpur") to Jorhat. This town was a flourishing and commercial metropolis but completely destroyed after a series of the Burmese invasions since 1817 till the arrival of the British force in 1824 under the Stewardship of David Scott and Captain Richard.

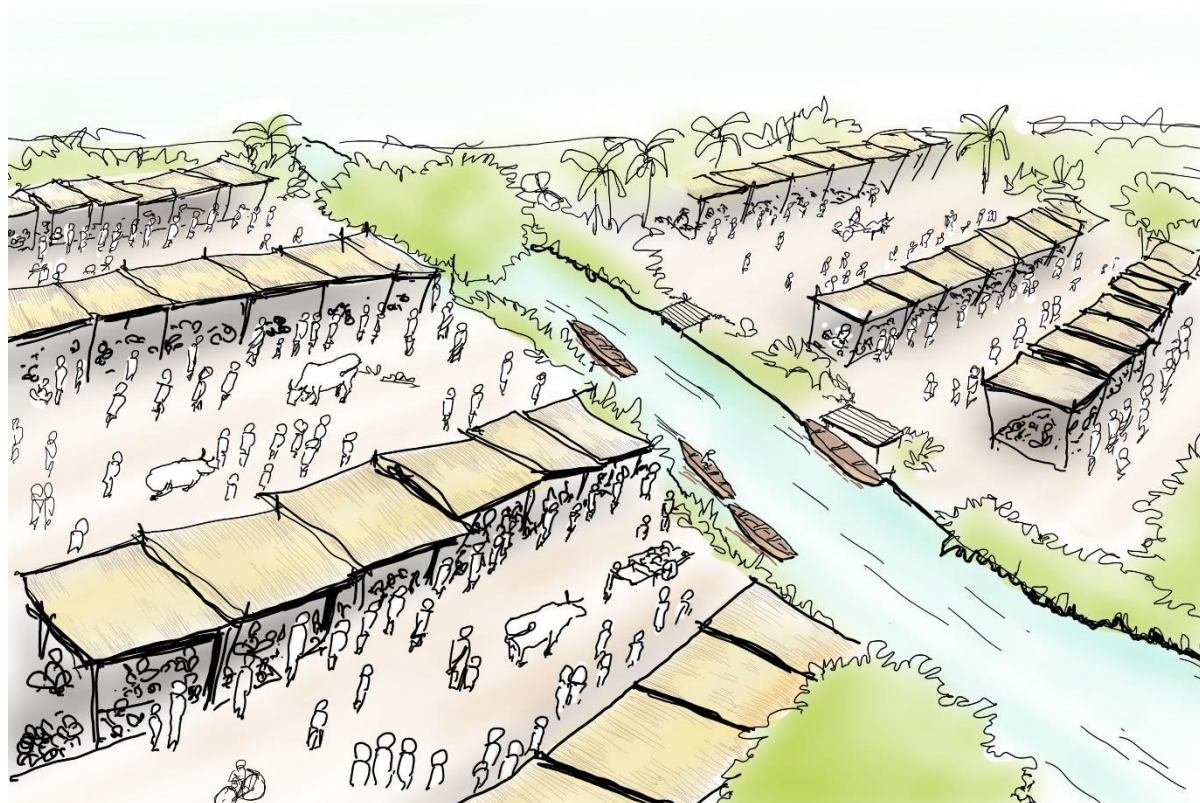


Figure 14: Illustration of the haats on the banks of Bhogdoi from where Jorhat got its name

The introduction of tea gardens was done by the British and Jorhat has the oldest Tea garden in Cinnamora. Also the British introduced open spaces like the Gymkhana club which is the oldest Golf course of Asia. Dhekiakhwa Bornamghar in Jorhat is one of the oldest and largest Naamghar. Jorhat is also known for the Tea festival celebrated each year in December. Jorhat has various Institutes like National Institute of Design, Assam Agriculture College, Regional Research Laboratory, and Jorhat Engineering College, which contributes to the population growth as well as the floating population of the city.



Figure 15: Gymkhana Club



Figure 16: Dakhinpatra Satra in Majuli

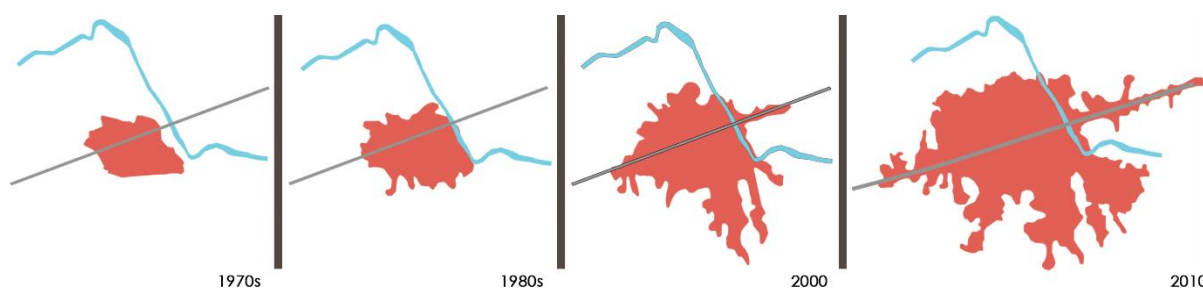


Figure 17: Spatial extension of built up of Jorhat city

2.3 Open spaces in Jorhat

The Jorhat district official website has listed only the five following as Public places and Gardens of the city.

- Millenium Park
- Mahatma Gandhi Park
- Rajabari Children Theme and Amusement Park, Rajabari, Jorhat
- Nehru Park, Jorhat
- Ganesh Gogoi Kabita Kanon

Apart from this Jorhat has the following open spaces

- Gymkhana Club (Private golf course)
- Jorhat sports field
- Jorhat Court field

Jorhat has total green area of 2.3 square meter per person and density of 7802 persons per square kilometre. City like Copenhagen has 42.4 square meter of green area per person and Density 6800 person per square kilometre. The URDPFI guidelines suggest that a city should have 10 to 12 square meter per person open space available, which is desirable.

Everyone is entitled to have more than just 12 square meter of open space in a city. And we must plan our cities aiming for higher open space per person which will

improve the quality of life and the city as whole. One of the reason to take Copenhagen as an example is because Denmark one of the happiest country of the world.

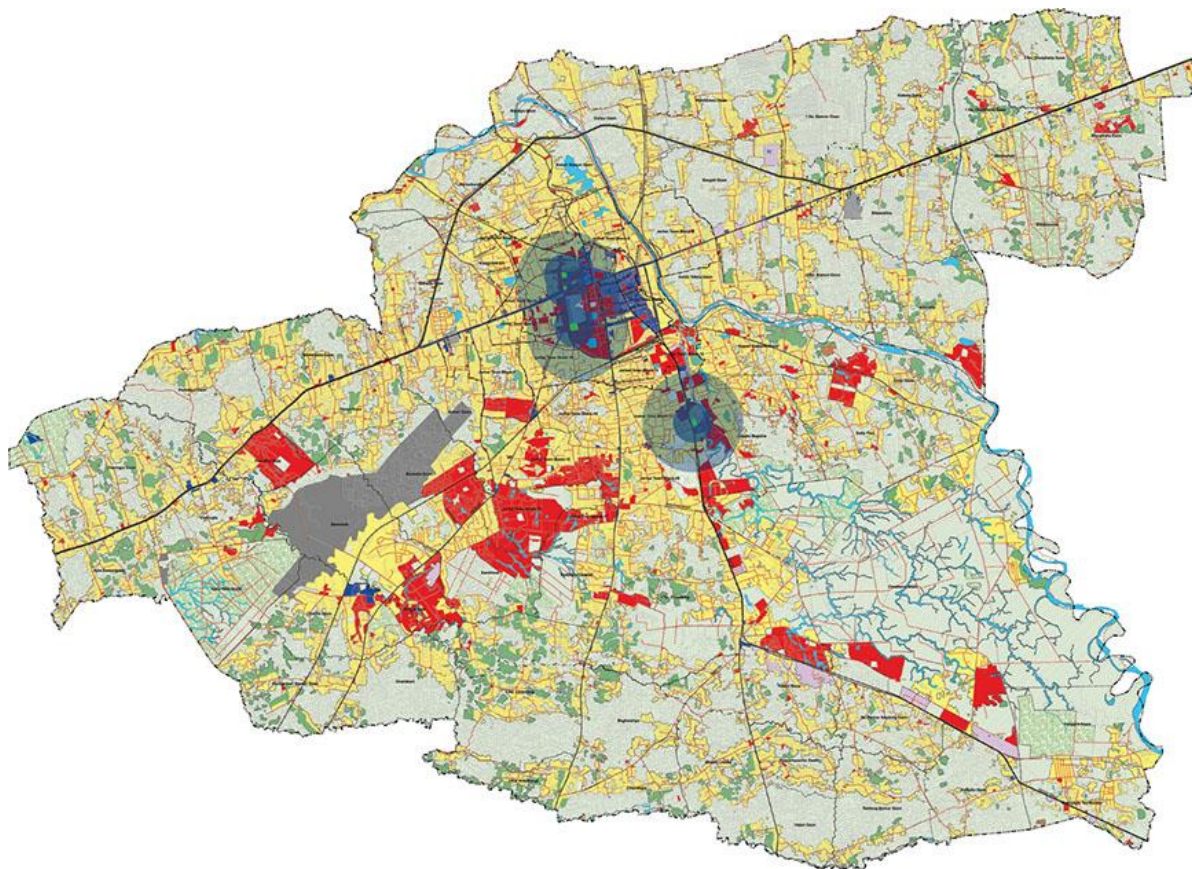


Figure 18: 400m and 800m distance from the centre of the public places and garden of Jorhat which is 5 and 10 minutes walking distance respectively Source: (Town and Country Planning, Jorhat , 2015)

We can understand from this study that there is an uneven distribution of parks in the city and it is not accessible by walking to major areas of the city. Again taking the example of Copenhagen, it started a municipal policy that all citizens by 2015 must be able to reach a park or beach on foot in less than 15 minutes. So we should be aiming towards a better open space structure in Jorhat.

The need of open spaces in Jorhat and neighbourhood parks for all age and gender is the current requirement of the city and also in the fringes before the open spaces are engulfed by the sprawl.

Jorhat town has seen a drastic change in land use pattern between 1962 and 2005, shrinking ecosystems with open areas and water bodies have both disappeared with alarming frequency with implications to the native species.

Almost 60% houses had a resident water body in their premises about 10-15 years ago. But this has decreased to almost half due to high land value, urbanisation pressure and climate. Forests have been lost and orchards cut. . The area under green belt and agriculture has reduced by more than 50%, area under parks and playgrounds by nearly 8%, while the land area under roads and railways increased by more than 45%.

3 Project Details

3.1 Aim

To develop an integrated framework for the open spaces in the fringes of a city to manage load of the future expansion of the city, taking Jorhat as a model.

3.2 Objective

- Landscape assessment of existing open spaces.
- To identify the open spaces in the site with their use like agriculture, ecologically sensitive areas, water bodies, etc.
- To create network of these open spaces in the site.
- To integrate the cultural aspects of the area so that it's not lost in time and maintain its identity.
- To demonstrate the intent in an area.

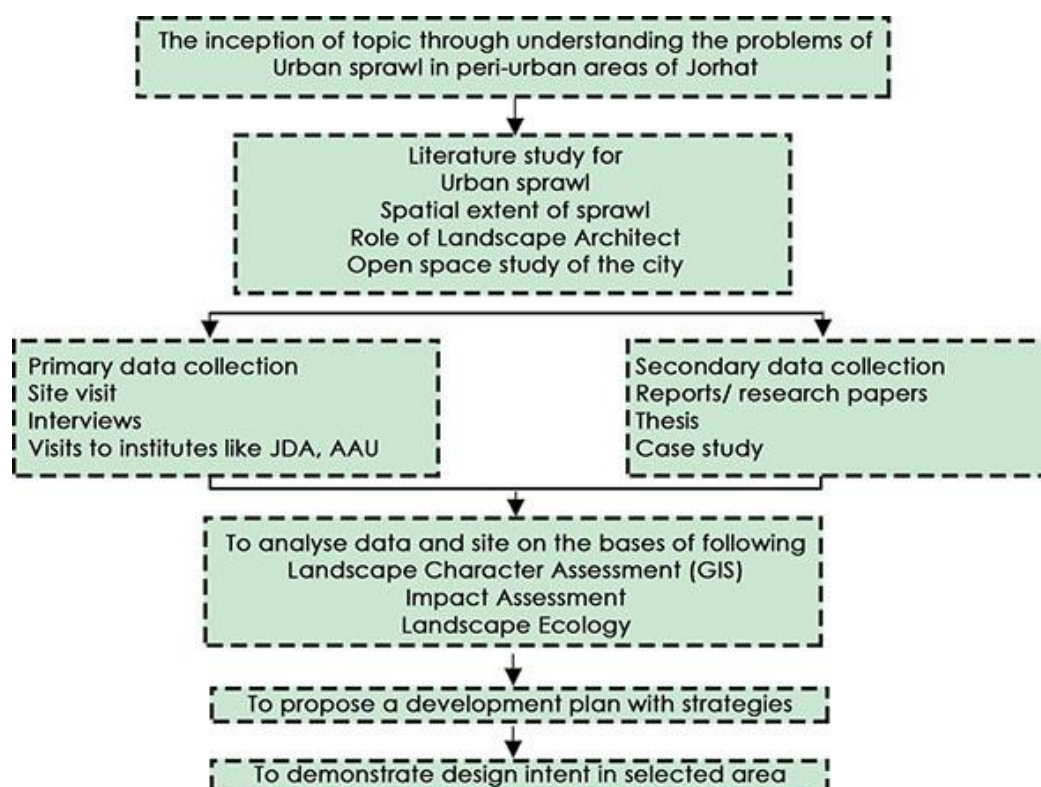
3.3 Need and relevance

The urban areas sprawl into their peri-urban areas and fail to understand that these fringes acts as a buffer to floods and droughts, reduce vulnerability of a city, safeguard the ecosystems and are the store house for cities. It is an urgent need to focus on these peri- urban areas as they will be the future urban areas.

3.4 Scope and limitation

As the spatial extent of rural-urban fringe of Jorhat is not determined, the area identified in the fringe for suitable immediate development (up to 4 to 6 kms) shall be considered the proposal.

3.5 Methodology



4 Literature Study

4.1 Urban open spaces

The importance of Urban open spaces

The quality of life of a city depends on the amount of green and open spaces in the city, and urban parks can contribute towards a healthier environment for any city both social and physical. Its benefits are

- Improvement in the physical and mental health such as reduced stress and blood pressure levels and better perceived physical health.
- Economic valuation of any property near parks or scenic views increase.
- A place for social and community building through gathering spaces for people from all backgrounds, age and gender

Proximity of the parks in the city

There should be proper distribution of open spaces throughout the city to prevent overuse or underuse of these spaces. The parks must be places where they are needed the most for better mixing of diversities, healthier urban environments. In her research, (The Spatial Logic of Parks, 2010), Emily Talen, tries to find logic for a better understanding of park distribution based on three spatial goals: proximity, diversity and social need. The positive benefits of proximity are better accessibility which, in turn, provides improved quality of life outcomes, emotional benefits and educational achievement (Kaplan & Kaplan, 1989; Chiesura, 2004; Kuo & Faber Taylor, 2004).

4.2 Ecosystem Services

On the basis of land use and land cover maps, this study identified ten major peri-urban ecosystems which can generate ecosystem services for urban areas.

Provisioning services

- Food provided by agriculture production
- Fresh water provided by the water bodies and surface drainage

Regulating services

- Water regulation Erosion regulation
- Water purification provided by wetlands

Cultural services

- Recreational and eco-tourism by natural ecosystem, agriculture, cultural landscape

Supporting Services

- Soil formation
- Nutrient regulation
- Primary production

4.3 Dong water harvesting system

'Dong' is a century old gravity based water distribution and management system of Assam. A series of channels are created starting from a main river or stream. These channels can be from four kilometre to fifteen kilometre long and serves four to five village. A series of channels are created starting from a main river or stream. These channels can be from four kilometre to fifteen kilometre long and serves four to five village. The channels not only helps in distribution of water in the paddy fields, it can have fishes which can be used for commercial purposes.



Figure 19: Dong water harvesting system

This system is being threaten and under used due to the ease of water access from the tube well provided by the government.

5 Case Study

The Ahmedabad Urban Development Authority (AUDA) master plan 2021 has demarcated Kathwada under the Residential Affordable Housing under the Town Planning Scheme. Kathwada is located outside the Ahmedabad Municipal boundary.

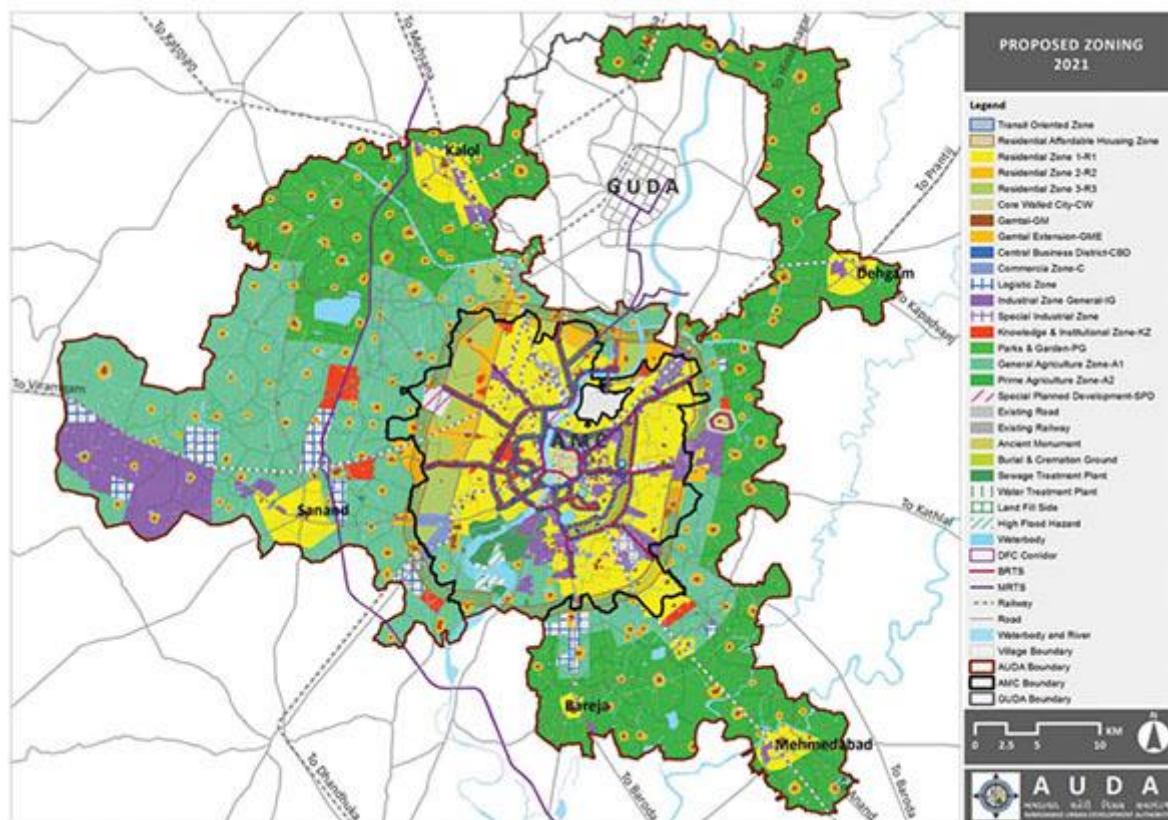


Figure 20: The AUDA proposed zoning 2021

Analysis

The proposals are marked outside the Gamtal boundary of Kathwada.

Open space structure is laid out considering the existing lakes and canals. Spaces are demarcated for uses like children play area, garden, community space.

The land use for the scheme majorly has been proposed as residential, hence the street sections have been designed in accordance, with consideration to create safer and better streets.

Pedestrian friendly wide footpaths have been proposed near the institutions and schools, with the provision of cycle tracks.

The sections near the recreational area is been provided with more focus on footpaths and side lanes for easy access from the neighbourhood.

AUDA take the plotted land is under designing and provide the amenities like road, space for community gathering, lake development with public spaces, etc.

Inferences

Positive

1. Open space network developed in accordance with the existing water body, also existing canals and paths
2. Open public spaces created near water bodies and community gathering spaces between plots.
3. Landuse is specified with plot division

Negative:

1. All road sections are developed with understanding of landscape or any low impact development.
2. No green spaces provided within the plots.

6 Site Analysis

6.1 Landscape Character Assessment

6.1.1 Climate

The climate of the area is humid subtropical. The mean annual air temperature is 23.5° C. The mean winter (December, January and February) and summer (June, July and August) air temperatures are 17.0° C and 28.7° respectively.

The mean annual precipitation (based on 10 years record from 1980-89) is 1950 mm. The rainfall is well distributed throughout the year, though major portion is received during March to September. Humidity is very high -98%

The predominant average hourly wind direction in Jorhat varies throughout the year. The wind is most often from the east for 4.3 months, from November 27 to April 5, from the south for 3.3 months, from May 22 to September 1, from the north for 2.9 months, from September 1 to November 27.

The climatic conditions and soil moisture regime favour both Kharif and Rabi cultivation without much supplemental irrigation and in some areas rabi crops are grown in rainfed condition. The low-lying areas are subject to flooding and water logging during rainy season.

There is temperature difference between the main road and the interior areas due to the presence of vegetation, which is drastically reduced on the road due to the construction of the road widening.

To provide shaded spaces, open planning to wind flow which help in relief from humidity, to provide trees lost due to road widening that provide shade as well help in reduce local temperature.

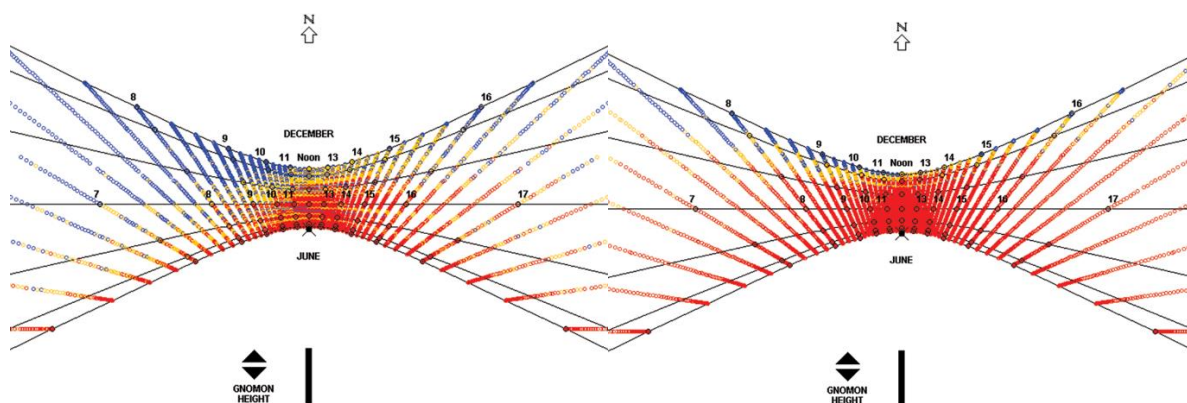


Figure 21: Sun path diagram

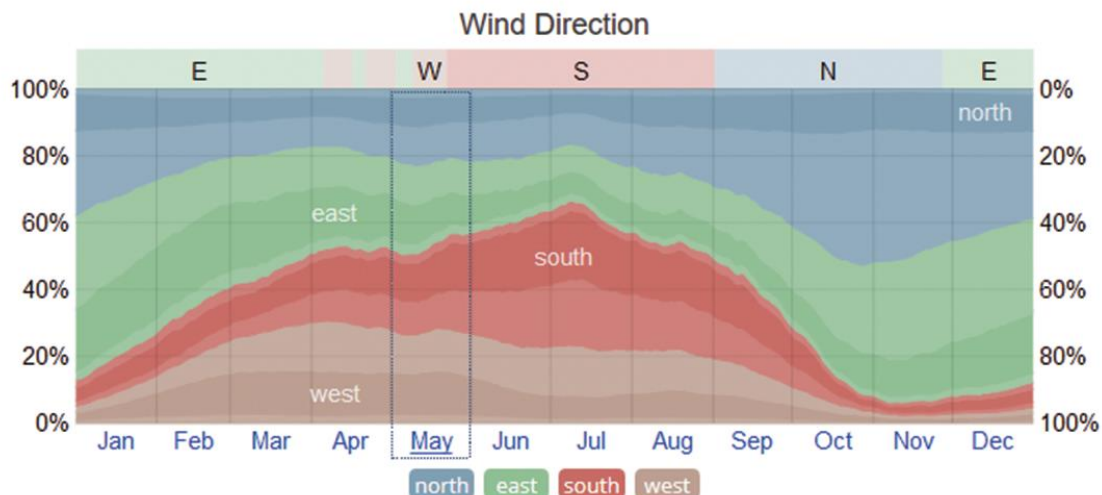


Figure 22: Wind direction

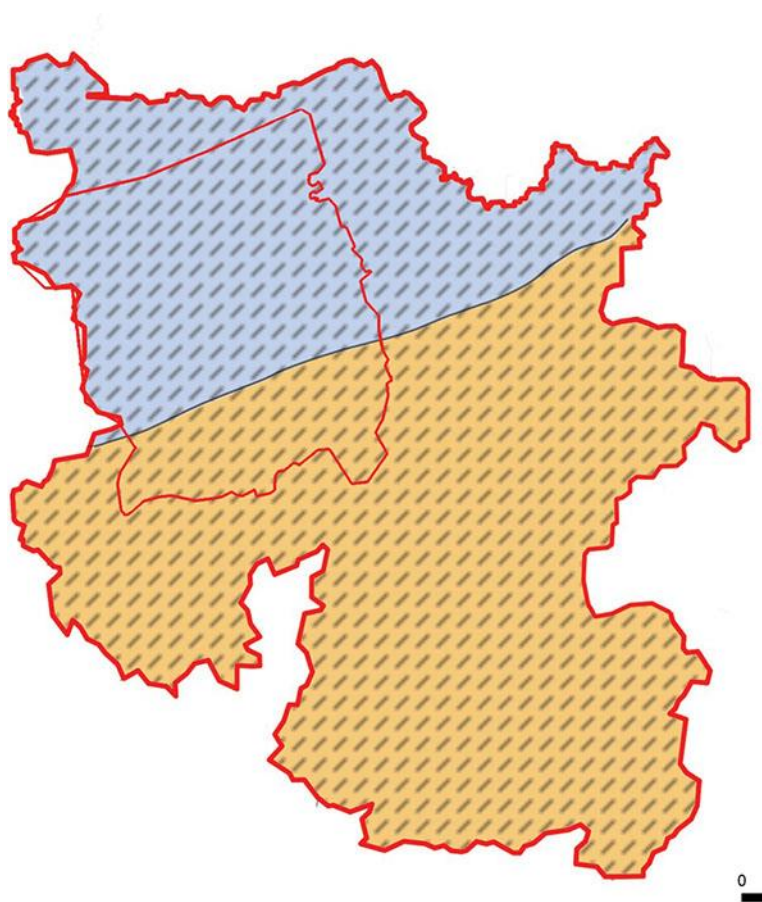


Figure 23: Geology

6.1.2 Physiography

The area represents a major part of the plains of the Brahmaputra valley at an altitude of about 60 m to 140 m above the mean sea level. The northern part of the valley is flat to nearly level and often subject to moderate to severe flooding whereas the other parts have very gentle slopes with impeded drainage and occasionally affected by flood and the area is mostly under paddy.

6.1.3 Geology

Most part of the district is covered by alluvium deposited by the river Brahmaputra and its tributaries. The older alluvium mainly of the Pleistocene period (less than 1 million years) consists of reddish to brownish sandy clay with coarser particles of sand and newer alluvium consists of sand, silt and clay along the plains of the Brahmaputra River.

There is only a thin strip along the eastern boundaries of the district, where rocks belonging to Tipam groups of sedimentary rocks of Tertiary period consists mainly of coarse to gritty, ferruginous sandstones and shales.

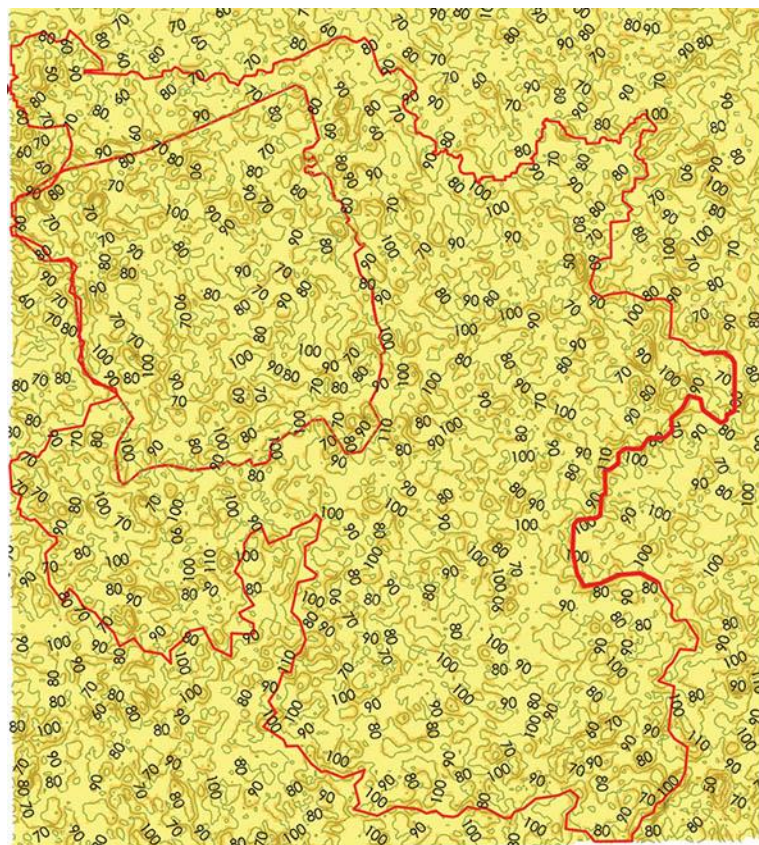


Figure 24: Slope

6.1.4 Slope

The site is flat to gentle slope. Such slopes are good for vehicular, pedestrian accessibility, buildable slope. Vegetation can easily propagate in these slopes. Native vegetation existing in the region can suggest what plantation can be proposed in these slopes.

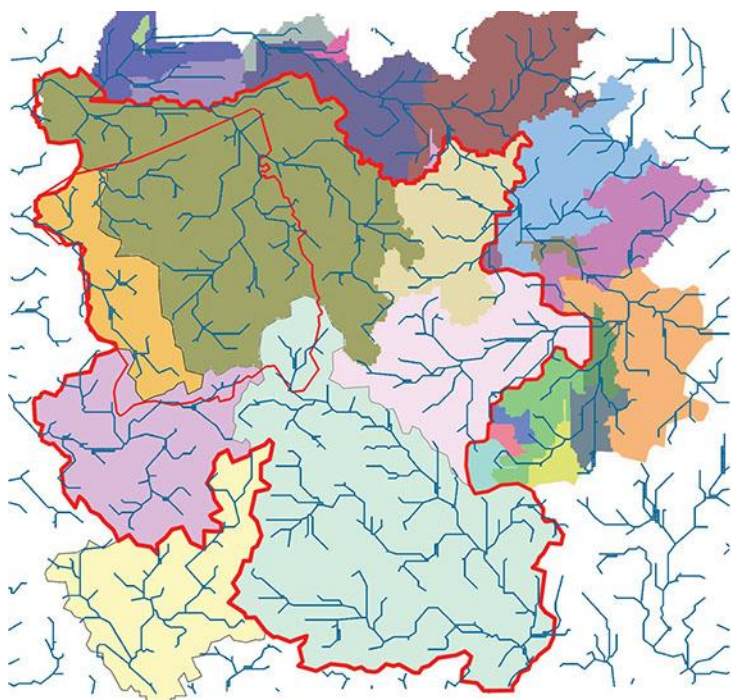


Figure 25: Hydrology

6.1.5 Hydrology

The Brahmaputra is the principal river that mainly drains the area. Its tributaries namely Jhanji, Bhogdoi and Kakodonga originating from the Naga Hills of the Purvanchal Hill ranges flow through the district. These along with a number of streams flowing from the south and southeast merge into the mighty river Brahmaputra in the north of the district.

Rational method of run off calculation

$$Q = CiA$$

C= Run off coefficient

i = Rainfall per hour (mm/hr)

A = Area (sq. mm)

Built	Farmland	Vegetation	Water body	Total
129.5	233.4	87.55	10.17	460.62

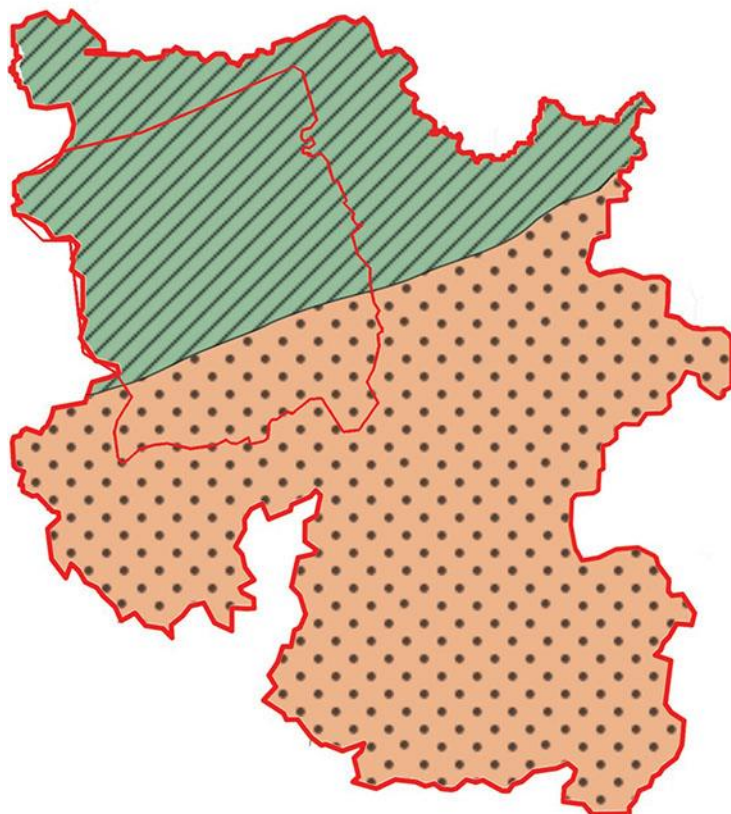


Figure 26: Soil

6.1.6 Soil

They have gray to dark gray, strongly to medium acid, sandy loam to loam, horizon and yellowish brown to strong brown, medium acid, sandy loam horizons which are mottled with gray to light gray colour.

Range in characteristics: The soils are very deep. the soil moisture regime is aquic. Surface soil colour is gray to grayish brown, texture is sandy loam to silt loam. The colour of subsoil ranges from brown to yellowish brown, texture is dominantly sandy loam. The subsoil is distinctly mottled with gray to light gray colour characterised with orange red Fe-Mn nodules. The structure is massive.

Drainage and permeability: Imperfectly drained with moderate permeability.

Use and vegetation: The soils are mostly under paddy and pasture land. The most common natural vegetation are Dot (*Ficus bengalensis*) Bogori (*Zizyphus jujube*), Kolajamu (*Eugenia Jambolana*) Bamboo (*Eambusa tulda*); Charai thengia (*Leea acuminata*) Ghontakarna (*Cimbalaria striata*); Bongooti (*Chrysopogon aciculatus*), Gahoribon (*Borreria articularis*) etc.

Interpretation: Problems of drainage, acidity and are susceptible to flooding. Rice is commonly grown in the Kharif; Mustard and wheat can be grown in rabi season.

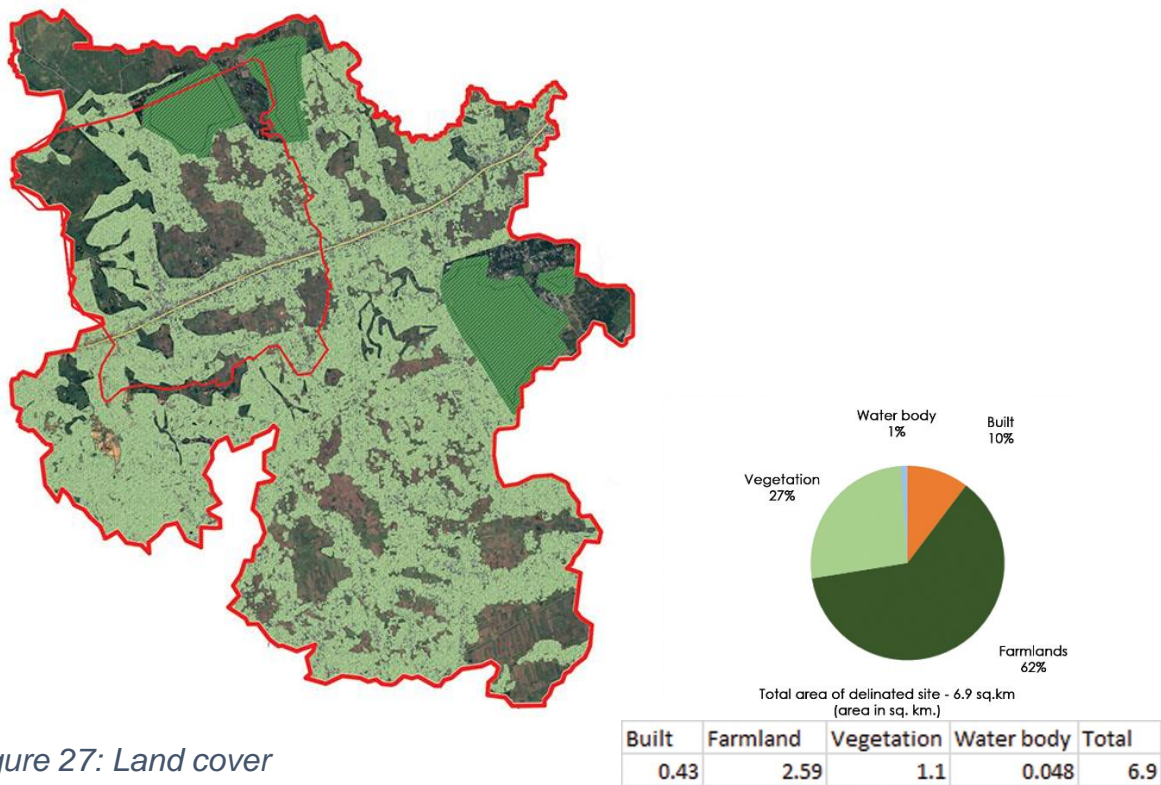


Figure 27: Land cover

6.1.7 Land cover

Forest type of Assam

In the “Revised Survey of Forest Types in India”, Champion and Seth categorized as many as fifty one different forest types/ sub types for this region. However, broadly speaking the forest in Assam can be described into following types/ sub types.

Tropical Wet Evergreen Forests, Tropical Semi Evergreen Forests, Tropical Moist Deciduous Forests

Co-ordinate the activities of the Biodiversity Management Committees: Sub-tropical Broadleaf Hill Forests, Sub-tropical Pine Forests, Littoral and Swamp Forests, Grassland and Savannahs.

Forest and Tree Cover

The estimated tree cover in the state is 1,564 sq km which is 1.99% of geographical area of the state. Forest cover in the state is 27,673 sq km that is 35.28% of the geographical area of the state. Thus the Forest and tree cover in the state is 29,237 sq km which is 37.27% of the geographical area.

6.2 Traditional Landscape Elements of Jorhat

6.2.1 Unit

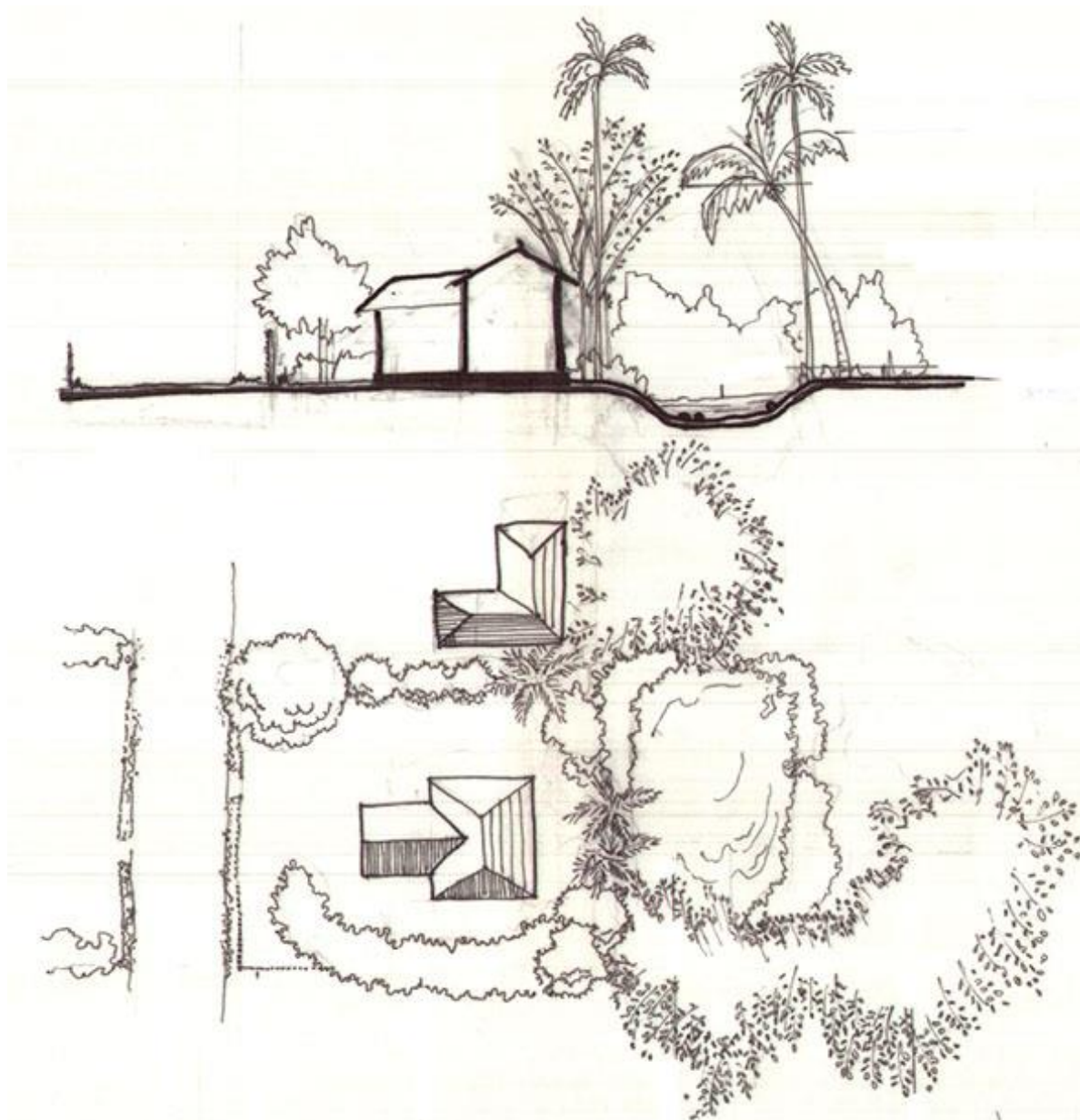


Figure 28: Plan and section of a unit

The landscape elements in a Unit

1. Homestead

A typical 'Bari' has medicinal plants like *Emblica officinalis* (Amla), *Terminalia* species (Hilika), *Zinziber officinalis* (ada), *Ocimum* species (Tulsi), *Curcuma aromatica* (ban-haldi), Lemon (Kaji nimbu) and ornamental plants like *Delonix regia*, *Hyctanthes arbor tristis*, *Gardenia radicans*, *Ixora coccinea*, etc., and

generally domesticated fauna can be found. It also serves as a stepping stone for species movement.

2. Bamboo Plantation or Bah Bari

Bamboo is widely cultivated in Assam and every household grows Bamboo. It is grown in homestead for various uses in day-to-day life - as food, medicine, construction of houses, fences, for fishing trap, baskets, in handicrafts, etc. It is also used for industrial use such as plywood, incense stick, pulp for paper, etc. Commonly cultivated species are-

1. Bambusa balcooa (Bhaluka bah), 2. bambusa tulda (Jati Bah), 3. Malocanna baccifera (Muli bah), 4. Dendrocalamus hamiltoni (Koko Bah), 5. Dendrocalamus giganteus (MokalmBah)

3. Resident Water Body or 'Pukhuri'

Almost every household in the rural area of Assam traditionally had a pukhuri. It is a traditional way of rain water harvesting through collection of surface runoff. Fishing from the 'pukhuri' is used for both domestic and economic use. It also attracts birds like kingfisher, white-breasted waterhen (Dauk), etc. The 'pukhuri' adjacent to the highway is disturbed due to the highway widening

4. Bamboo fence

Fence made of bamboo traditionally and creepers can be found on it.

5. Plantation near water body

Shrubs are different and coconut trees can be found. Sometimes merges with the Homestead

6. Open space in individual house

The open space in individual houses serves as the family gathering space, even occasions like weddings are organised here

7. Typical Assam type house

Assam type houses are generally ground floor with sloping roof.

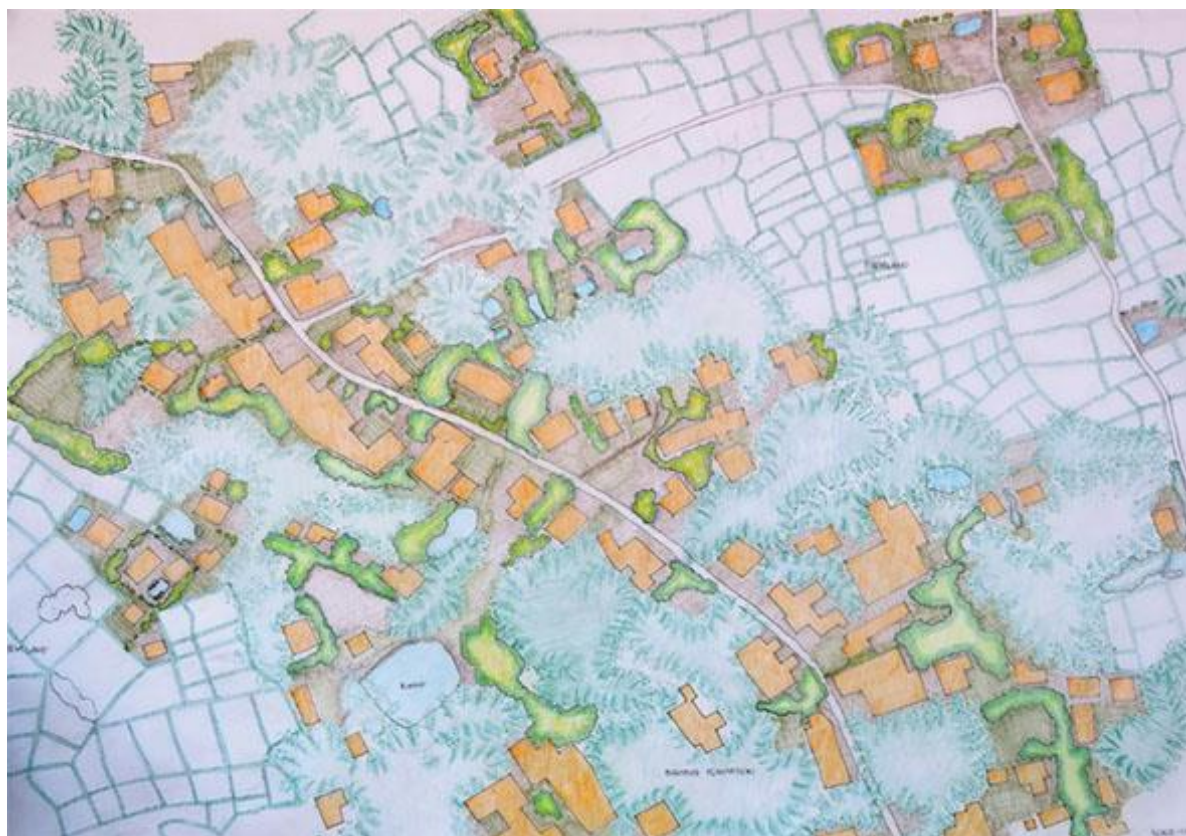


Figure 29: Plan of a cluster

6.2.2 Cluster

The landscape elements found in cluster

1. Farmlands- 'Pathar'- The major crop in Jorhat is paddy. According to NBSSLUP, Nagpur. Paddy- 56.6%, Tea- 17.7%, Oil seeds- 7.7%, Vegetables- 7.5%, Spices- 1.4%, Fruits- 4.5%, Pulses- 0.7%, Others- 21.8%. Birds like Egrets (Bogoli), common Myna (maina), can be found in the fields. Cow graze in the farmlands.
2. Pukhuri in farmlands are used for irrigation purposes. And as community spaces specially near Naamghar.
3. Dong system- A century old traditional gravity based water management and distribution system of Assam. This system can serve four to five villages through the channels, created from a river or stream, which can be four to fifteen kilometre long. The system is being lost slowly as government is providing tube well of irrigation. But due to the depletion of ground water there are problems in irrigation of the fields.

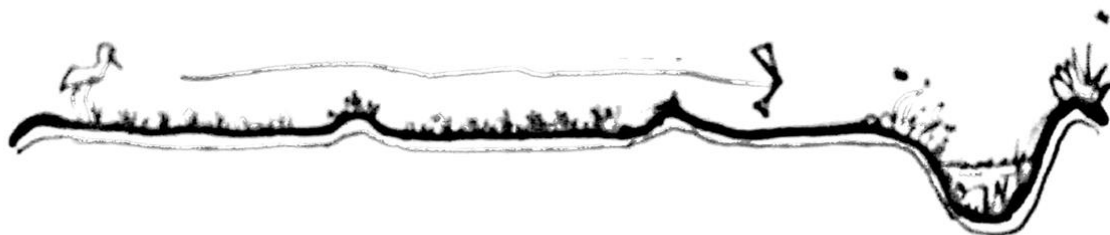


Figure 30: Flow of water towards the main dong channel through the individual farm parcel



Figure 31: Plan of Farmland with residence and dong system



Figure 32: View of the farmland

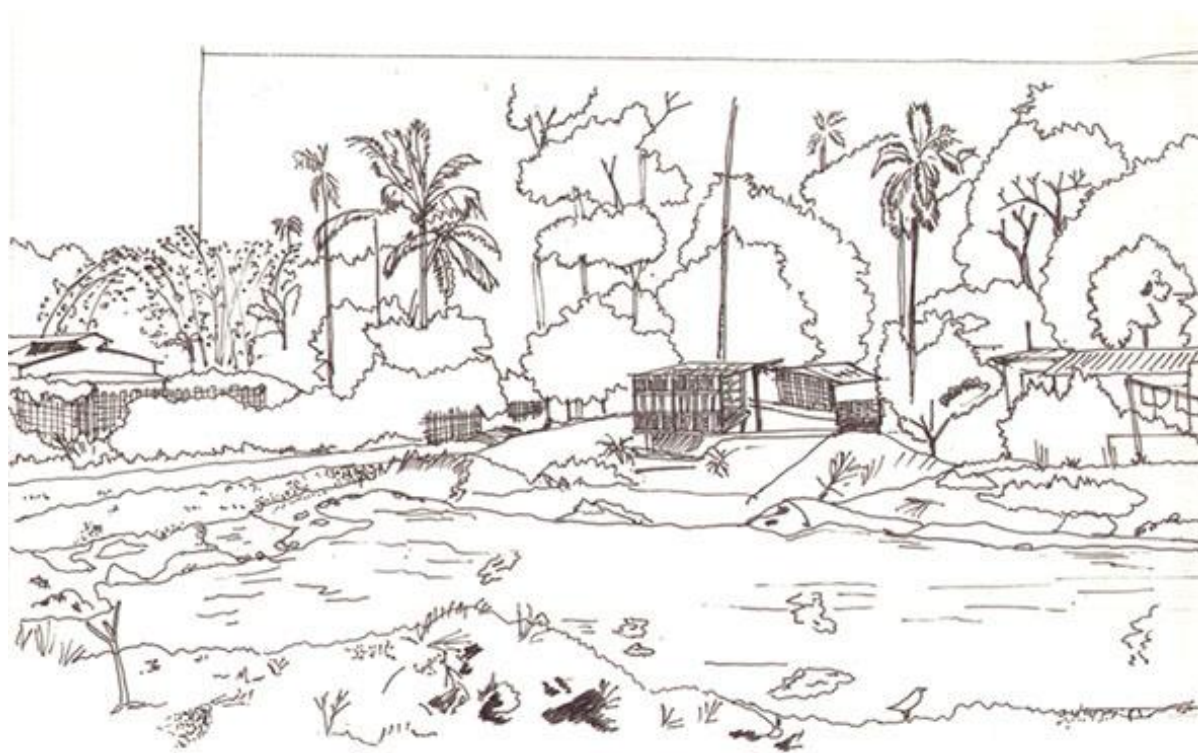


Figure 33: Cluster in the background and disturbed landscape in the foreground

The list of the plants found in the 'bari' and in wild in Jorhat are mentioned below

List of Ornamental plants found in A 'Bari'				
Title	Plant type	Local name	Scientific name	Commercial/ non-commercial
Mirabilis jalapa	Herb	Godhuli gupal	Mirabilis jalapa	Non commercial
Clitoria ternatea	climber	Aparajita	Clitoria ternatea	Non commercial
Cassia fistula	Tree	sunaru	Cassia fistula	Commercial
Delonix regia	Tree	krisnasura	Delonix regia	Commercial
Ixora coccinea	Shrub	Rangol ful	Ixora coccinea	Non-commercial
Gardenia angusta	Shrub	togor	Gardenia angusta	Commercial
Aerides multiflora	Epiphytic herb	Kopou ful	Aerides multiflora	Commercial
Papilionanthe teres	Epiphytic herb	vatouful	Papilionanthe teres	Commercial
Catharanthus roseus	Herb	Nayantora	Catharanthus roseus	Non-commercial
Thevetia peruviana	Small tree	Korobi	Thevetia peruviana	Non-commercial
Jasminum malabaricum	Scandent shrub	khorkajai	Jasminum malabaricum	Commercial
Nyctanthes arbor- tristis	Shrub	sewali	Nyctanthes arbor- tristis	Commercial
Hibiscus rasa-sinensis	Small tree	raktajoba	Hibiscus rasa-sinensis	Commercial
Rosa alba	Shrub	Boga gulap	Rosa alba	Commercial
Rosa indica	Shrub	Gulapful	Rosa indica	Commercial
Polianthes tuberosa	Herb	Rajanigandha	Polianthes tuberosa	Commercial
Cassia renigera	Tree	Radhasura	Cassia renigera	Non-commercial
Bauhinia purpurea	Small tree	Boga Kansan	Bauhinia purpurea	Non-commercial
Tabernaemontana divaricata	Small tree	Kathna	Tabernaemontana divaricata	Non-commercial
Cascabela thevetia	Small tree	Korobi	Cascabela thevetia	Non-commercial
Rauvolfia serpentina	Under shrub	Sarpagondha	Rauvolfia serpentina	Non commercial
Polianthes tuberosa	Shrub	Narji	Polianthes tuberosa	Commercial
Polianthes tuberosa	Herb	Rajnigondha	Polianthes tuberosa	Commercial
Nyctanthes arbor-tristis	Short tree	Hewali	Nyctanthes arbor-tristis	Commercial
Nymphaea pubescens	Aquatic herb	Bhet phul	Nymphaea pubescens	Commercial
Rhynchosytilis retusa	Epiphytic herb	Kopou	Rhynchosytilis retusa	Commercial,non commercial
Leucas aspera	Herb	Durum bon	Leucas aspera	Non commercial

<i>Erythrina indica</i>	Tree	Modar	<i>Erythrina indica</i>	Non commercial
<i>Clerodendrum glandulosum</i>	Under shrub	Nefafu	<i>Clerodendrum glandulosum</i>	Non commercial
<i>Datura metal</i>	Under shrub	Dhatura	<i>Datura metal</i>	Non commercial
<i>Cymbopogon nardus</i>	Herb	Chitronola	<i>Cymbopogon nardus</i>	Both
<i>Tacca thanirieri</i>	Herb	Jokhini ful	<i>Tacca thanirieri</i>	Non commercial
<i>Lantana camara</i>	Shrub	Gu phool	<i>Lantana camara</i>	Non commercial
<i>Peperomia pellucid</i>	Herb	Pononua	<i>Peperomia pellucid</i>	Non commercial
<i>Dendrobium aphyllum</i>	Epiphytic herb	Salikithuria phool	<i>Dendrobium aphyllum</i>	Non commercial
<i>Couroupita guianensis</i>	Shrub	Nagchampa	<i>Couroupita guianensis</i>	Commercial
<i>Calotropis gigantean</i>	Shrub	Akon	<i>Calotropis gigantean</i>	Non commercial
<i>Magnolia champaca</i>	Small tree	Champa	<i>Magnolia champaca</i>	Non commercial
<i>Mimusops elengi</i>	Tree	Bakul	<i>Mimusops elengi</i>	Commercial
<i>Pinanga gracilis</i>	Palm	Geruka tamul	<i>Pinanga gracilis</i>	Commercial

List of Medicinal plants found in A 'Bari'				
Title	Plant type	Local name	Scientific name	Landscape/habitat
<i>Paederia foetida</i>	Climber	Vedailota	<i>Paederia foetida</i>	Homestead
<i>Hydrocotyle sibthorpioides</i>	Herb	Sorumanimuni	<i>Hydrocotyle sibthorpioides</i>	Homestead
<i>Centella asiatica</i>	Herb	Bormanimuni	<i>Centella asiatica</i>	Homestead
<i>Musa paradisiaca</i>	Herb	kaskol	<i>Musa paradisiaca</i>	Homestead
<i>Phyllanthus acidus</i>	Herb	Matiamlokhi	<i>Phyllanthus acidus</i>	Homestead
<i>Houttuynia cordata</i>	Herb	Mosondoi	<i>Houttuynia cordata</i>	Homestead
<i>Azadirachta indica</i>	Tree	Neem	<i>Hydrocotyle sibthorpioides</i>	Homestead
<i>Leucas indica</i>	Herb	Durum	<i>Leucas indica</i>	Homestead
<i>Mentha piperita</i>	Herb	Podina	<i>Mentha piperita</i>	Homestead
<i>Ocimum americanum</i>	Herb	Tulsi	<i>Ocimum americanum</i>	Homestead
<i>Bacopa monnieri</i>	Herb	Brahmi sak	<i>Bacopa monnieri</i>	Homestead
<i>Tylophora indica</i>	Shrub	Anantamul	<i>Tylophora indica</i>	Homestead
<i>Catharanthus roseus</i>	Herb	Nayantora	<i>Catharanthus roseus</i>	Homestead
<i>Eclipta prostrata</i>	Herb	Keheraj	<i>Eclipta prostrata</i>	Homestead

Envisaging the Peri-Urban Landscape of Jorhat, Assam

Psidium guajava	Tree	Modhuri	Psidium guajava	Homestead
Colocasia esculenta	Herb	Kola kochu	Colocasia esculenta	Homestead
Terminalia arjuna	Tree	Arjun	Terminalia arjuna	Homestead
Aloe vera	Herb	Sal kuori	Aloe vera	Homestead
Solanum viarum	Under shrub	Bhakuri tita	Solanum viarum	Homestead
Piper betle	Climber	Pan	Piper betle	Homestead
Zingiber officinale	Herb	Ada	Zingiber officinale	Homestead
Curcuma domestica	Herb	Halodhi	Curcuma domestica	Homestead
Carica papaya	Tree	Omita	Carica papaya	Homestead
Aegle marmelos	Tree	Bel	Aegle marmelos	Homestead
Musa	Herb	Kol dil	Musa sp.	Homestead
Punica granatum	Tree	Dalim	Punica granatum	Homestead
Citrus grandis	Tree	Rabab tenga	Citrus grandis	Homestead
Phyllanthus emblica	Tree	Amlokhi	Phyllanthus emblica	Homestead
Citrus	Tree	Gool nemu	Citrus sp.	Homestead
Terminalia chebula	Tree	Silikha	Terminalia chebula	Homestead
Musa balbisiana	Herb	Athia kol	Musa balbisiana	Homestead
Averrhoa carambola	Tree	Kordoi	Averrhoa carambola	Homestead
Garcinia kydia	Tree	Kuji thekera	Garcinia kydia	Wild
Cucumis sativus	Climber	Tioh	Cucumis sativus	Homestead
Hedyotis diffusa	Herb	Bon jaluk	Hedyotis diffusa	Homestead
Datura metal	Short tree	Dhatura	Datura metal	Homestead
Cannabis sativa	Shrub	Bhang	Cannabis sativa	Homestead
Basella alba	Climber	Puroi sak	Basella alba	Homestead
Ricinus communis	Under shrub	Era gos	Ricinus communis	Homestead
Clerodendrum viscosum vent	Shrub	Dhopat tita	Clerodendrum viscosum vent	Homestead
Tabernaemontana divaricata	Short tree	Kathna	Tabernaemontana divaricata	Cosmopolitan
Houttuynia cordata	Herb	Mati kaduri	Houttuynia cordata	Cosmopolitan
Momordica charantia	Climber	Kerela	Momordica charantia	Homestead

List of Wild species found in Jorhat				
Title	Plant type	Local name	Scientific name	Habitat
Erythrina indica	Tree	Modar	Erythrina indica	Forest & roadside area
Ficus religiosa	Tree	Ahot	Ficus religiosa	Forest,roadside area
Bombax ceiba	Tree	Ximolu	Bombax ceiba	Forest & homestead area
Citrus maxima	Small tree	Sokola tenga	Citrus maxima	Forest & homestead area
Cassia fistula	Tree	Sonaru	Cassia fistula	Forest & roadside area
Citrus grandis	Small tree	Robab tenga	Citrus grandis	Forest & homestead area
Dillenia indica	Tree	Outenga	Dillenia indica	Forest & homestead area
Ficus auriculata	Tree	Mon dimoru	Ficus auriculata	Forest & homestead area
Lagerstroemia reginae	Tree	Azar	Lagerstroemia reginae	Forest & roadside area
Mesua ferrea	Tree	Nahor	Mesua ferrea	Forest
Gmelina arborea	Tree	Gomari	Gmelina arborea	Forest & homestead area
Melia azedarach	Tree	Ghura neem	Melia azedarach	Forest & homestead
Mangifera indica	Tree	Aam	Mangifera indica	Forest & homestead area
Sapindus mukorossii	Tree	Monisaal	Sapindus mukorossii	Forest & homestead area
Psidium guajava	Tree	Modhuri	Psidium guajava	Homestead area,forest
Mesua ferrea	Tree	Nahor	Mesua ferrea	Forest ,homestead area
Spondias pinnata	Tree	Omora	Spondias pinnata	Forest,homestead area
Terminalia chebula	Tree	Xilikha	Terminalia chebula	Forest,homestead area
Tamarindus indica	Tree	Teteli	Tamarindus indica	Forest & homestead
Magnolia	Tree	Titasopa	Magnolia spp.	Forest & homestead

Source: (India Biodiversity Portal, 2018)

6.3 Impact Assessment

6.3.1 *Impact of Highway and urbanisation*



Figure 34: Site analysis on the basis of impact

The view of the cultural and rural landscape is very limited due to the change in the architectural style of the built up areas on the road. The stream network and the roads have zones of conflict where certain design measures must be taken so that there is no hamper in the flow of water. The junctions are major points of accidents and must be designed in a way to avoid accidents. The green spaces provides species movement and must be connected for the same. Any loss of connection will also lead to loss of the species population in this area.

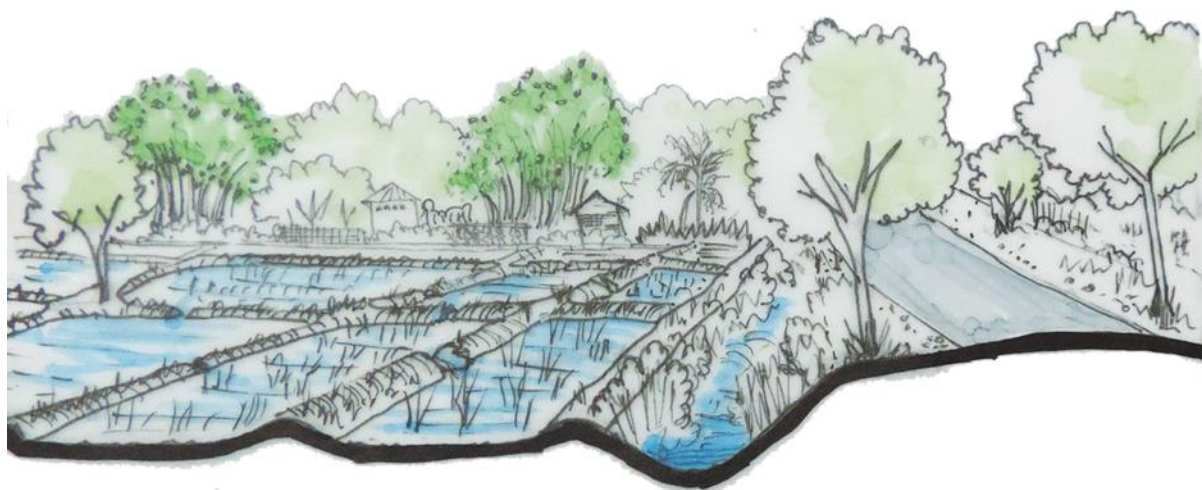


Figure 35: Section at A through road and farmland (Originally)

Roadside plantation, Bioswale around the farmland or pathar, traditional use of material for house and fencing, natural flow of water to the swale



Figure 36: Section at A through road and farmland (Existing)

Distressed roadside landscape with filling of the ponds and felling of road side trees, Change in land use, change in the architecture style, Concrete drains instead of bioswales



Figure 37: Elevation at B through the internal road

Homestead or 'Bari' in almost all residence, Use of traditional material like bamboo, mud, etc. for the construction of residence or shops, Traditional Assam type house with sloping roof, Traditional landscape can be seen



Figure 38: Elevation at C through the main road

The road side development has a drastic change in architectural style then the interior areas. The 'bari' and open space is lost in the individual unit. There is no setback regulations followed.

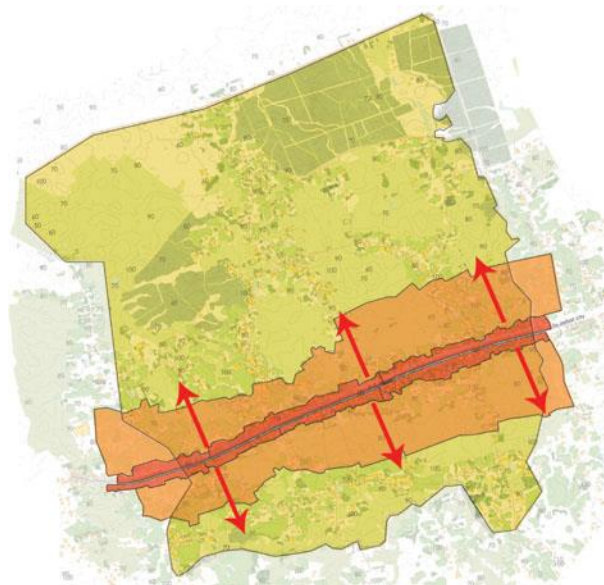


Figure 39: Impact of highway



Figure 40: Impact of the Natural resources

High Impact Zone

On predominantly Natural elements

- Hydrology - no event of flooding recorded in this area, but chances of flash floods like in the city has increased due to the encroachment on roadside swales, resident water body (pukhuri)
- Vegetation - Felling of road side trees and fragmented vegetation
- Fauna - the fragmentation affects the fauna

Cultural activities

- High risk of accidents of both human and cattle
- Loss of traditional architecture and elements
- View of the cultural landscape is hampered

Medium Impact Zone

On predominantly Natural elements

- Hydrology - Any disturbance in the upper catchment create issues in the lower area
- Due to urbanisation, there can be issues like overuse, rapid run off, contamination, flooding

Cultural activities

- The landscape is still intact than the high impact zone.

Low Impact Zone

On predominantly Natural elements

- Hydrology - Less negotiate impact on the stream and pukhuri due to the highway but to keep it intact, guidelines for the same must be provided.

- Vegetation - tea garden towards the interior areas

6.3.2 Impact of Natural resources

	Farmlands	Bamboo	Tea garden	Homestead	Water bodies	Dongs	Plantation
Provisioning Services							
• Food	●	●	●	●	●		●
• Fresh water					●		
• Raw materials	●	●					●
• Medicinal requiremnets		●		●			●
Cultural Services							
• Aesthetics	●	●	●	●	●		●
• History/ Education		●	●	●		●	
• Tourism	●	●	●				●
• Recreation	●	●	●		●		
Regulating Services							
• Infiltration- groundwater recharge		●	●	●	●	●	
• Storm water management	●		●		●	●	
• Local climate and air quality		●		●	●	●	●
• Biological control		●		●			
• Pollination		●	●	●			●
• Carbon sequestration and storage		●		●			●
Supporting Services							
• Habitats for species		●	●	●	●	●	
• Maintenance of genetic diversity		●		●			

6.4 Issue Identification

Environmental

- Fragmentation of the landscape might lead to extinction of species
- Eutrophication of water body near the road
- Obstruction of the stream network due to infrastructure
- Any disturbance in the upper catchment create issues in the lower area
- The rapid development, without proper design or consideration of slope, can destruct the natural systems like the water channels, slope stabilisation, etc.
- The site is on the lower flood plain, thus any changes without consideration of hydrology can weaken the natural systems.
- The site is susceptible to erosion as it is located in the lower flood plain.

Social / Cultural

- Safety concern for pedestrian on the highway where no pedestrian pathway not provided as Junctions and Nodes are not designed properly.
- Cattles / domestic animals might get into Accidents
- Lack of community gathering spaces leads to loss of various traditions
- Loss of the water harvesting system - Dongs used for irrigation for farmland
- Loss of the traditional Assamese architectural style
- The knowledge of use of the homestead plantation, Bamboo plantation is getting lost due to changes in the “urban” lifestyle.
- Change in land cover and land use effects the cultural landscape of the rural setting, especially in the main road.
- Improvement in the road side facilities and amenities

Economic

- Selling of farmlands is one of the fastest way of earning instant money, but that leads to loss of farmlands thus agriculture practices.
- The change in occupation specially leaving the traditional art like handloom, jewellery making, agricultural for other fast and more income generating occupation due to urbanisation.

7 Development Strategies



Figure 41: Development plan

Different regulation for different zone in the site

1. Conserved- The light green colour larger areas marked that shall be left undisturbed from human activities
2. For future Development- Areas demarcated for residential land use in the future
3. For recreation – The dark green areas are marked for any passive or active recreations which might include parks, playgrounds, social gathering space
4. For commercial/ industrial purpose

Environment

- The areas demarcated as high natural, biological and landscape or cultural related values. Generally these parks are characterised by a high level of plant and animal biodiversity.
- Restrictions and regulations at regional and local level to be provided. Only Passive recreation and controlled activities can be allowed. The development process might be hampered due to such exclusions.
- The water systems are fragile and it is easy to neglect this while planning or designing.
- The site is on the lower flood plain, thus any changes without consideration of hydrology can weaken the natural systems.
- The connected streams with vegetated edges that will provide connection and work as corridor for species movement.
- Culverts where necessary to maintained the flow of natural drainage.
- The stream, 'pukhuri' to have a buffer of 20m for any kind of permanent construction.
- Bamboo plantation not to be altered, edge condition must stay irregular as it allows the movement of species.
- To revive and strengthen the dong system, that collects run off from the fertilised field that can be filtered naturally.

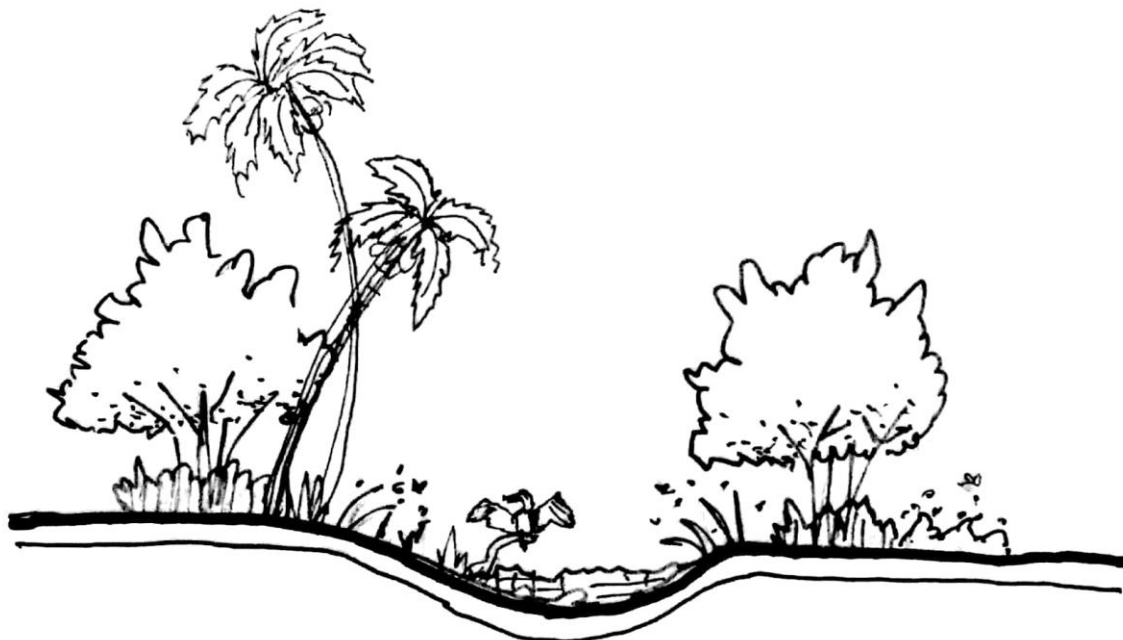


Figure 42: Streams with vegetated edges

Social/ Cultural

Community engagement, communication and awareness rising community building

- The areas that has the values of both predominantly naturally and partially altered lands such as farmlands 'pathar', bari which may also include ecologically sensitive areas such as green corridors can be used for passive recreation.
- Parks, playgrounds, etc. to be created at intervals for equitable use, it can express various forms of environmental features and values.
- Revival of Dong system and preserving the ones that exist in the farmlands and the swales in the tea garden
- Community spaces or recreation spaces to be created within the existing bamboo plantation and near community 'pukhuri'
- Better design to mitigate accident
- Design for commercial spaces in strategic locations
- Recreational activities along the pond or stream like boating, fishing, camping, etc.



Figure 43: Community gathering spaces for festivals, panchayat meetings



Figure 44: Recreation spaces around 'pukhuri'

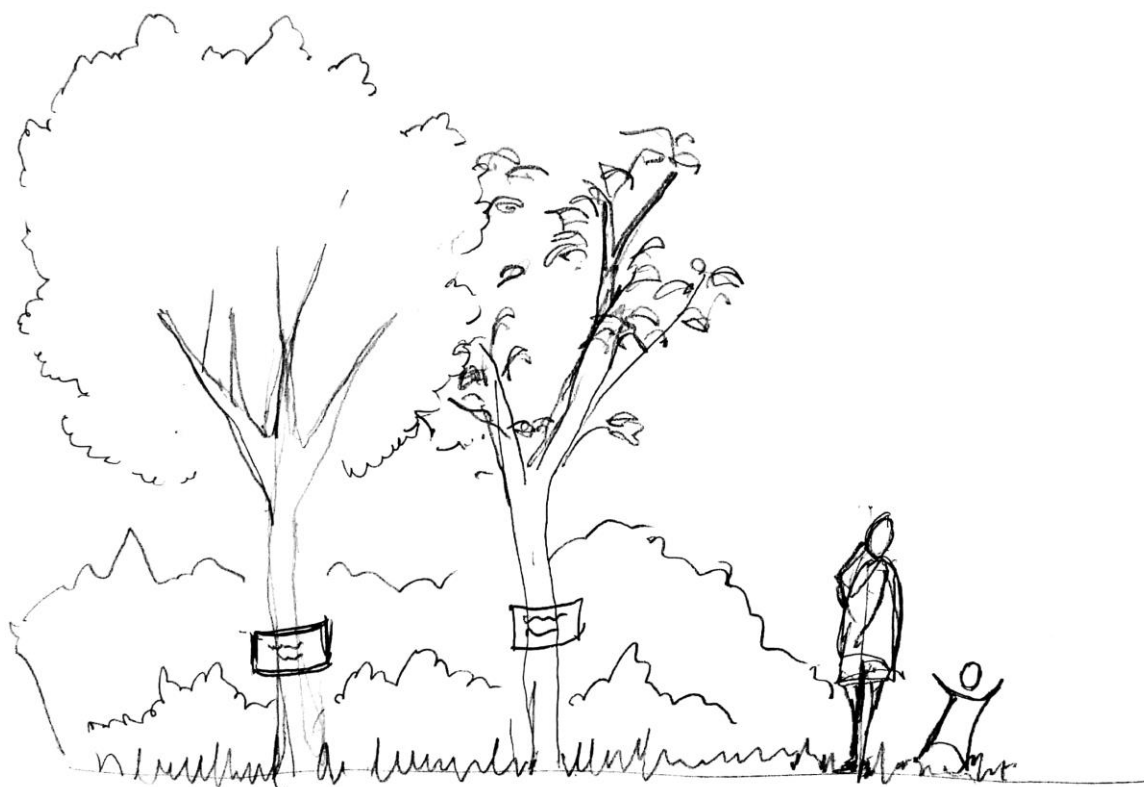


Figure 45: Trails for educating purposes like species information

Economic development

- Conservation of Tea garden, water bodies and farmlands as they are major part of the economy of the city. These areas can also be used for passive recreation.
- Spaces for the traditional haat for economic growth and also for workshops that promote the traditional handicrafts and practices.
- Collaboration with private partners like Tata Trusts who work to empower the Indian Handloom industry and women

Provision of highway side amenities and facilities like shops, eateries, petrol pump. Service stations for trucks and cars, etc. but should follow the following

- Any spillage or pollutants must be treated in the site, only than released any stream
- It should follow the setback rules



Figure 46: Haat with spaces for handicraft workshop

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