

RESEARCH ARTICLE

Geo-Environmental problems associated with Mariani town, Jorhat, Assam

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ABSTRACT

A geo-environmental study of an area analyses the physical, chemical, and biological components of the environment to understand and manage them sustainably. It involves mapping resources, assessing natural hazards like floods, erosion and planning for sustainable land use. Geo-environment refers to the geographical and environmental factors effecting the natural landscape of an area. This paper aims to examine the principal geo-environmental problems affecting the town of Mariani with emphasis on river pollution, water quality and supply issues, flood and erosion hazards, land-use change and solid-waste management, and anthropogenic impacts. The study uses government data, local institutional reports, regional news and peer-reviewed literature to for identification of existing problems, categorisation of the factors or underlying drivers, and suggest few mitigation, monitoring and planning actions appropriate for a rapidly changing peri-urban area of Mariani town which is dominated by tea gardens and transport infrastructure.

KEYWORDS Geo-Environment, Hazard, Pollution, Flood

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A geo-environmental study of an area analyses the physical, chemical, and biological components of the environment to understand and manage them sustainably. It involves mapping resources, assessing natural hazards like floods, erosion and planning for sustainable land use. Geo-environment refers to the geographical and environmental factors effecting the natural landscape of an area. This paper aims to examine the principal geo-environmental problems affecting the town of Mariani with emphasis on river pollution, water quality and supply issues, flood and erosion hazards, land-use change and solid-waste management, and anthropogenic impacts. The study uses government data, local institutional reports, regional news and peer-reviewed literature to for identification of existing problems, categorisation of the factors or underlying drivers, and suggest few mitigation, monitoring and planning actions appropriate for a rapidly changing peri-urban area of Mariani town which is dominated by tea gardens and transport infrastructure.

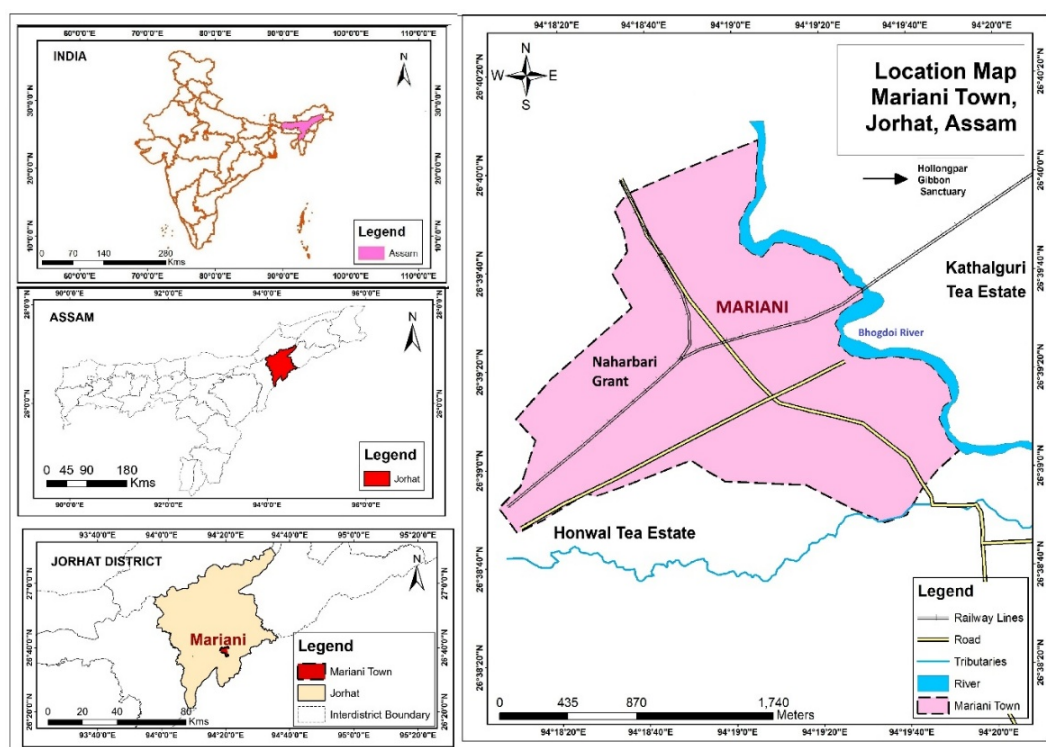
KEYWORDS Geo-Environment, Hazard, Pollution, Flood

INTRODUCTION

Mariani is a key town located in the Jorhat district of Assam, strategically important for its tea industry. Geographically, it is located between 26°38' N – 26°40' N latitude and 94°18' E – 94°18' E longitude, with an elevation of about 104–125 meters above mean sea level and total area of 3.61 sq. kms (Fig 1). Mariani is positioned on the southeastern periphery of Jorhat district, approximately 17.5 km from Jorhat city, and serves as a major transit point between Assam and Nagaland due to its proximity to the inter-state boundary. Located in the foothills of the Naga Hills it has a topography of gentle sloping from southwest to north-west. The town's location in the fertile alluvial plains of the Brahmaputra Valley makes it a significant centre for tea production and allied agro-based activities. Mariani is famous for the Gibbon Wildlife Sanctuary which is located in the east of Mariani town. The Mariani

Junction on the Lumding–Dibrugarh rail line makes the town an important transport node. The local economy is closely tied to tea gardens and related labour settlements; population estimates from census aggregates place the town's population at roughly 20,801 as per the 2011 census data, with 10,781 males and 10,020 females (Census, 2011). These geographic and socio-economic features (tea estates, transport infrastructure and riparian systems) shape the primary environmental vulnerabilities covered in this study.

Figure 1: Location of study area



Source: Generated by Author using GIS from boundary map Mariani Municipal Board

METHODOLOGY

The following paper is a synthetic study using various published and unpublished sources of data, personal study, field observation, primary data, reports and government bulletins. Published data like Government and municipal documents and datasets (census, district profiles), local institutional reports such as Mariani College's green/environmental audit, regional investigative reporting and peer-reviewed or technical literature on rivers, tea-garden hydrology and railway/industrial impacts in northeast India, and news sources documenting recent hazards and administrative responses (flood events, drowning bans, pollution complaints) were used to complete the research and draw the conclusive measures.

DISCUSSION

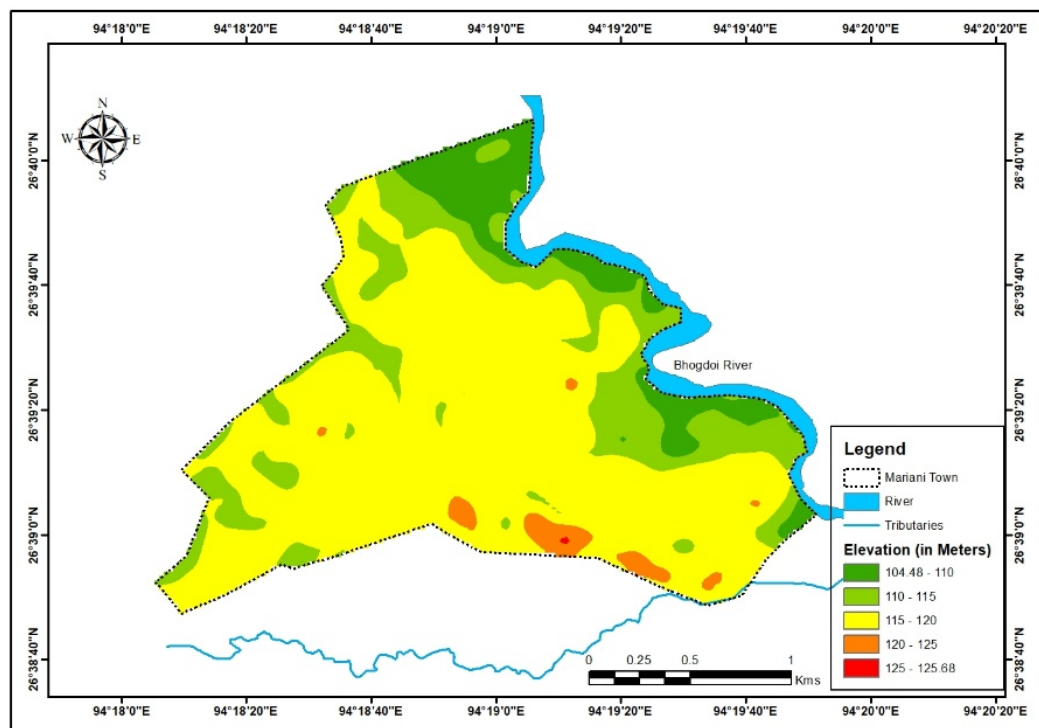
A. Physiographic Description of Mariani Town

The town of Mariani is situated within the Upper Brahmaputra Valley, one of the most prominent physiographic divisions of Assam. Physiographically, it is located in gently sloping uplands (dissected). With close proximity to the Naga hills, the town lies surrounded by the foothill range in the south.

B. Relief and Topography

The topography of Mariani is generally undulating to gently sloping, forming a transition zone between the plains of the Brahmaputra Valley and the foothills of the Naga Hills. The elevation of Mariani town lies between 102 to 145 meters above mean sea level, with gradual rises toward the southeast, where the hilly terrain of Nagaland begins. The Digital Elevation Model and contour map of Mariani town (Figure 2 & Figure 3) describe the elevation and relief of the study area. The relief of the study area can be classified as low-lying alluvial plains, interspersed with small hillocks and forested tracts.

Figure 2: Relief of Study Area

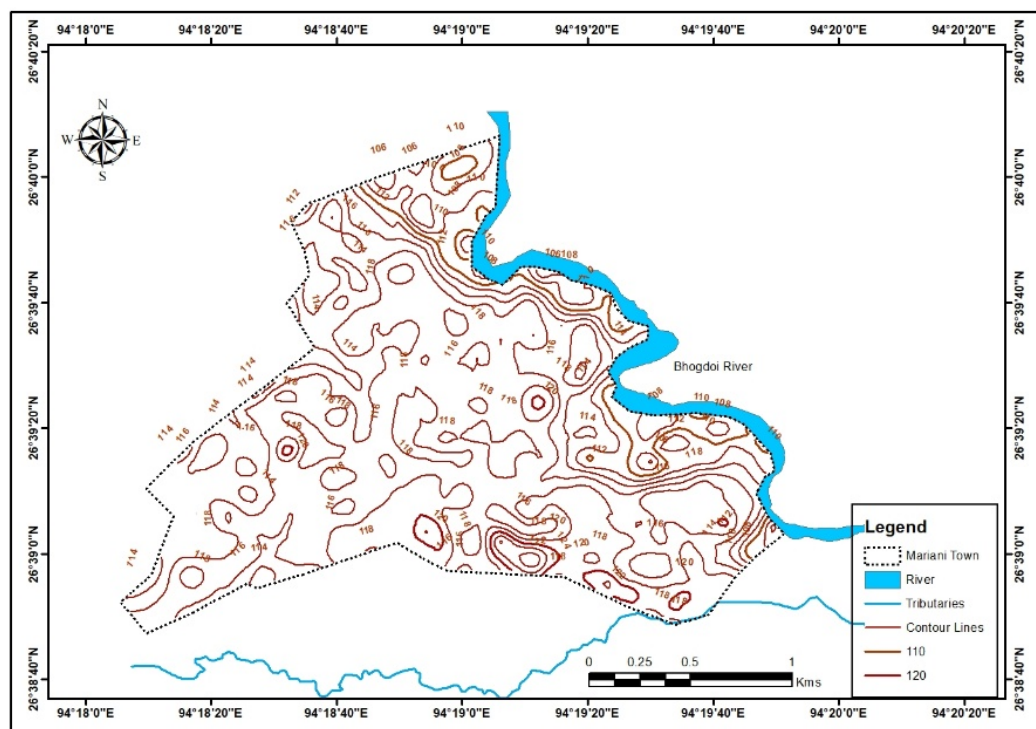


Source: Generated by Author using GIS

Slope

The overall landform has a gentle slope from south-east to north-west, following the general gradient of the Brahmaputra River basin. Many areas have very gentle slopes (1–3%), especially the northern alluvial plains. A significant portion of the town has

Figure 3: Contour Map of Study Area



Source: Generated by Author using GIS

nearly level to very gently sloping terrain. Moderate slopes are found in the foothills and along the southern parts where it merges with the Naga Hills (Figure 3).

Geology and Soil

The region is underlain predominantly by recent alluvial deposits of the Quaternary period, composed of sand, silt, clay, and gravel brought down by the tributaries of the Brahmaputra River. The soils are fertile alluvial and lateritic, supporting extensive tea plantations, which are a defining feature of Mariani's landscape. The slightly acidic nature of the soil, along with the humid climate, makes it ideal for tea cultivation. Landform or relief have played significant role in the formation of soils in the area. Soil Taxonomy is Typic Dystrochrepts-Typic Udorthents in the Mariani Town. Soils of the town and the surrounding parts are characterised by very deep, moderately well drained, brownish yellow, fine silty soils having silt loam surface soils with slight to moderate erosion hazards

Drainage and Hydrology

Mariani is drained by several small streams and rivulets, the most prominent being the Bhogdoi River, which flows nearby before joining the Brahmaputra. During the monsoon, heavy rainfall often leads to waterlogging and seasonal flooding in the low-lying areas in the northern part of the town.

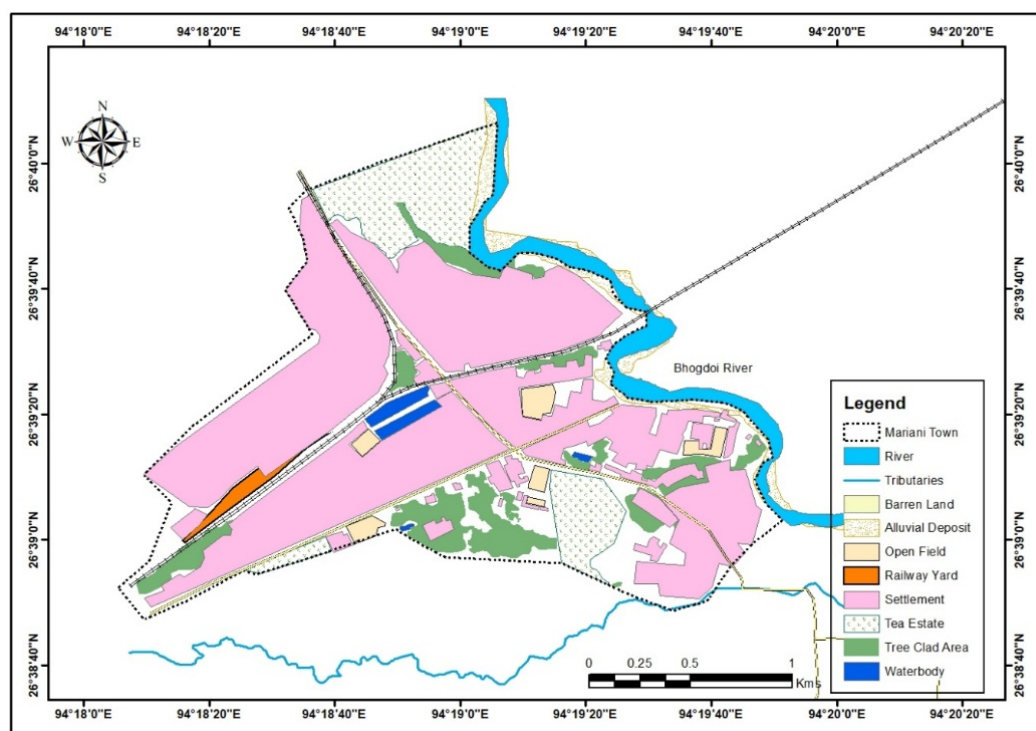
Climate

The town experiences a humid subtropical climate, characterised by hot, wet summers and cool, dry winters. The average annual rainfall exceeds 2,000 mm, most of which occurs between May and September due to the southwest monsoon. The high humidity and ample rainfall contribute to the lush greenery and dense vegetation in and around Mariani.

Vegetation and Land Use

Natural vegetation in the surrounding area consists mainly of moist deciduous forests, though much of it has been cleared for tea gardens and settlements. The landscape is dominated by tea estates, interspersed with patches of bamboo, sal, and mixed evergreen species. Agricultural lands primarily support paddy, vegetables, and areca nut plantations are located outside of the town area. Over all the land use is dominated by Built up area covering 2.01 sq. kms, followed by tree covered areas of 0.44 sq. kms and tea estates of 0.4 sq. kms, waterbodies and railway yards.

Figure 4: Land-use of Study Area



Source: Generated by Author using GIS

C. Geo-environmental problems

River Pollution and Declining River Health

Over the years, there has been an increase in contamination and ecological decline in local rivers serving Mariani and the surrounding tea gardens, particularly the Bhogdoi which serves as one of the major tributaries of mighty river Brahmaputa. Bhogdoi flows in a south-east to North-west direction throughout the eastern

boundary of Mariani town area and enters Jorhat town finally joining the river Brahmaputra. Major pollutants like waste discharge, and possibly effluents from upstream coal/mining or industrial activities have degraded water quality, affected drinking water reliability for communities, and even caused perceptible changes such as bitter taste or stickiness reported by residents. The loss of river health undermines local livelihoods (tea workers, fisheries), increases public-health risk and reduces resilience to droughts and floods (Singh, 2021). Unregulated or inadequately treated effluent discharges, encroachment and illegal dumping, agricultural runoff from tea gardens, and sedimentation. Institutional monitoring and enforcement gaps are commonly reported (Singh, 2021).

Problems of water contamination in tea-garden households

The Tea Garden communities are dependent on local surface waters or shallow groundwater for their day-to-day use. According to ground water assessment reports around Mariani town, there exists a scarce water supply which is safe. Several communities residing in these tea estates have complained of polluted potable sources of water from time to time. This creates a chronic shortage of safe drinking water security. Strengthening community water treatment and extending reliable water sources are priority interventions for the town (Bharadwaj, 2021).

Flooding

Although Mariani sits inland away for close proximity to flood affected areas near tributaries of Brahmaputra, however, artificial floods or flash floods effect small parts of few of the tea gardens, agricultural land and local infrastructure seasonally for very short duration. However, floods within the town area are not much devastating or larger frequency or intensity.

Land-use change and habitat fragmentation

Mariani's land use comprises built-up areas, tea estates, pockets of natural vegetation and transport infrastructure. Expansion of built-up areas such as – settlements, railway yards, development of commercial infrastructure and intensification of tea cultivation has gradually led to fragmentation of habitats, change of soil exposure due to land use change, changing pattern of runoff and storm water leading to reduced rate of groundwater recharge. Lack of a proper planned management of the land use and stormwater management has increased surface runoff, causing localised floods seasonally and erosion in the slopes of Mariani Town. Mariani town have been exposed to pressure of land use change due to the rising population and growth of settlement, causing mushroom growth of buildings to fulfill the growing need. Thus, proper perspective of study and management of the geo-environment of Mariani needs to be prioritised urgently.

Solid waste management

Challenges in municipal solid-waste collection, segregation and sanitary disposal are most commonly faced problems in Mariani. Poorly managed waste blocks drainage, becomes a source of pathogen transmission, and aggravates vector-borne disease risk during monsoon. Several observations highlight the need for improved local and municipal solid-waste practices; town-wide systems require capacity strengthening.

Pollution from transport & industrial facilities

Mariani Junction's transport activity and the development of a diesel locomotive shed introduce potential air particulate and pollutants from diesel engines, noise and soil contamination risks (hydrocarbons, lubricants). Historical industrial activity in and around Mariani (e.g., reference to large plywood factories historically in the area) suggests legacy pollution hotspots may exist in abandoned industrial sites or associated waste pits which require targeted assessment.

RECOMMENDATIONS

The recommendations below are organised by short, medium and long term and aims to provide a systematic approach for management of the existing geo-environmental problems of the town.

Short-term measures

Rapid environmental assessment: Water and sediment quality testing for Bhogdoi and other local water bodies is suggested to identify pollutant loads and hotspots (parameters: DO, BOD, coliforms, heavy metals, hydrocarbons). This will inform enforcement and health advisories (Singh, 2021).

Safe-water interventions: For vulnerable tea-garden villages that need infrastructure improvements, provide community water treatment (chlorination points, portable filters) (Bharadwaj, 2021).

Drain and solid-waste clean-up drives: During the monsoon season, solid waste need to be collected and clogged drains should be cleaned up by the municipality for safe disposal and temporary segregation. As a result, less urban garbage will be generated in open fields and disposed of in rivulets and waterbodies.

Pollution source control and enforcement: Identification of the main industrial and municipal point sources of pollution, and enforcement of effluent regulations, and mandate treatment for any industrial discharges into the Bhogdoi basin (Singh, 2021)

Green buffer and riparian restoration: To lessen bank erosion, enhance habitat, and filter runoff, reforest riparian buffers with native plants. Promote the use of contour planting and soil conservation techniques in tea gardens (Choudhury, 2025).

Improve water supply infrastructure: Increase municipal water supply to town wards and tea garden settlements while also improving groundwater recharge through managed infiltration techniques (percolation ponds, recharge wells) and rainwater harvesting methods (Bharadwaj, 2021).

Long-term strategies

Integrated watershed management: Using GIS for hazard maps and land-use change detection, create a Jorhat-Mariani catchment plan that coordinates district, municipal, and tea estate stakeholders for flood mitigation, land-use planning, and pollution control (Choudhury, 2025).

Environmental and transportation sustainability measures: It include mitigating air pollution at diesel sheds, containing hydrocarbon runoff, and making tracks and embankments climate-proof.

Community engagement and livelihoods: To guarantee community engagement in sustainable measures for the town's long-term planning, combine environmental restoration with livelihood support, such as eco-restoration employment, tea-garden worker water committees, etc.

Research and monitoring priorities:

To enable adaptive management and eliminate evidence gaps:

Extensive spatial and temporal monitoring of Bhogdoi's water quality, as well as that of nearby streams and groundwater wells that supply tea gardens (Singh, 2021).

Using remote sensing and local surveys, geohydrological mapping (floodplain, slope stability, erosion hotspots) needs to be done with the aim of prioritising structural and nature-based solutions (Choudhury, 2025).

Industrial/railway environmental audits to identify contamination at legacy industrial sites and pollution controls required at the locomotive shed.

Sociological studies on water access, sanitation practices and community coping strategies in tea-garden labour settlements to design appropriate interventions (Bharadwaj, 2021).

CONCLUSION

Mariani's geo-environmental challenges are directly related to the complex geodynamics of the natural landscape and its anthropogenic activities. Thus, to mitigate the existing geoenvironmental problems, we need to prioritise focusing on identifying the critical hotspots, strengthen municipal waste and drainage systems, and prepare integrated watershed and land-use plans that protect riparian systems while supporting local livelihoods. Coordination among municipal authorities, district disaster management, tea estate management, government bodies and civil society will be essential. Watershed-level planning, stronger pollution control, and community-centered adaptation are the town's urgent need of the hour resolutions (Singh, 2021). With targeted monitoring and mixed nature-based and infrastructure measures, Mariani can reduce environmental risks and improve resilience for its communities.

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