# Spatial Correlation between Demographic Patterns and Flood-Prone areas in Jorhat District, Assam

**Sangeeta Saikia[1], Dr. Nurul Amin[2]**

[1]Assistant Professor, Department of Geography, Nanda Nath Saikia College, Titabar
Email: *saikia.sangeeta[at]gmail.com*

[2]Associate Professor (Retd.), Jagannath Barooah University, Jorhat

**Abstract:** ***The Brahmaputra basin in Assam is one of the most flood-prone regions in India, with recurrent floods causing severe socio-economic impacts. Jorhat district which is located in the Upper Brahmaputra Valley, experiences recurrent inundation, particularly in specific localities. This study examines the spatial correlation between demographic patterns and flood-prone zones in Jorhat district using Geographic Information System (GIS) techniques. A dataset of 10 frequently flood-affected villages was analyzed, including parameters such as total households, total population, gender distribution, and child population (0–6 years). Flood hazard zones were delineated using satellite-derived flood extent maps and Digital Elevation Model (DEM) analysis. Spatial overlays were conducted to identify demographic clusters in high-risk flood zones. Results show that villages with higher population densities and household counts, such as No.2 Kawoimari Gaon, Kolbari and Bahfalla Gaon, coincide with zones of high flood frequency. This correlation highlights the urgent need for targeted flood mitigation strategies focusing on the most vulnerable communities.***

**Keywords:** GIS, flood-prone zones, Jorhat district, demographic patterns, Brahmaputra basin, vulnerability mapping

## 1. Introduction

Floods are a recurring natural hazard in the Brahmaputra valley of Assam, with significant impacts on human life, livelihoods and infrastructure. In Jorhat district, the annual monsoon floods are exacerbated by riverbank erosion, high sediment load and low-lying terrain. Certain villages experience repeated inundation, leading to persistent socio-economic vulnerability. Understanding the spatial relationship between population distribution and flood-prone areas is crucial for disaster preparedness and resource allocation.

While earlier studies have examined large-scale flood risk in Assam, fewer have integrated village-level demographic data with geospatial flood hazard mapping. This study focuses on the spatial correlation between demographic parameters—such as household density, population size and age composition - and the extent of flood-prone areas in Jorhat district, using GIS as the primary analytical tool.

**Objectives of the Study**

1) To identify and map the frequently flood-affected villages in Jorhat district using GIS and remote sensing data.
2) To analyze demographic patterns (household distribution, total population, gender ratio, and child population) in frequently flood-prone areas.
3) To delineate the flood hazard zones based on the elevation, proximity to water bodies, and historical flood inundation records.
4) To examine the spatial correlation between demographic concentration and the extent/intensity of flood hazard zones.
5) To develop a vulnerability index combining demographic parameters with flood hazard exposure for prioritizing high-risk villages.
6) To propose targeted flood mitigation measures**,** including Nature-Based Solutions (NBS), suitable for the identified high-risk demographic clusters.

## 2. Study Area

Jorhat district lies between 26°46′N to 27°09′N latitude and 94°09′E to 94°40′E longitude, bounded to the north by the Brahmaputra River. The district has predominantly alluvial floodplain topography, with several tributaries contributing to its hydrological network. The dataset used for this study focuses on 10 villages identified as frequently flood-affected, distributed mainly across North-West Jorhat, Kaliapani and Central Jorhat blocks.

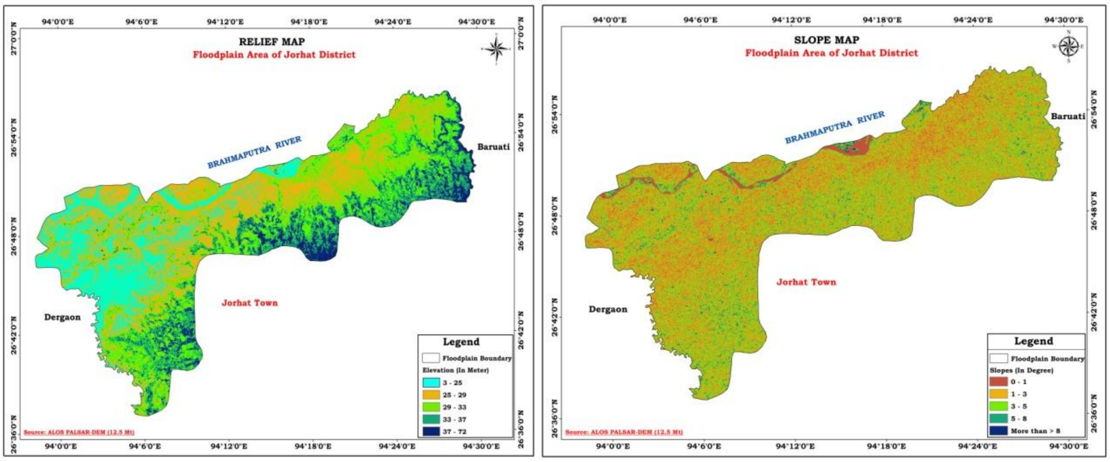


**Figure 1:** Relief & Slope Map of the study Area

## 3. Data and Methodology

### 3.1 Data Sources

a) <u>Village-Level Demographic Data</u>: Provided dataset of 10 flood-affected villages including total households (THH), total population (TP), male population, female population and child population (0–6 years).

b) <u>Satellite Data:</u> Sentinel -1 microwave satellite dataset was used to identify the flood inundation areas of Jorhat district. Similarly, to study the topographic components such as elevation, slope etc. Copernicus-DEM (30 m resolution) was applied in the present study.

c) <u>Ancillary Data:</u> Administrative boundaries block boundaries and village boundaries were collected from Assam State Space Application Centre (ASSAC). NRSC Bhuvan Thematic services were utilized to observe and collect the Decadal pattern of flood prone areas in the flood prone areas of Jorhat district. Flood layers from 1998 to 2010 were used to identify frequently affected areas. Similarly, the Flood Hazard Zonation Atlas prepared by NRSC (National Remote Sensing Centre) was considered for the present study.

### 3.2 Methodological Framework

- Flood Affected areas were identified from Sentinel-1 satellite imagery using Threshold backscatter values (17 – 20 dB in VH polarization)
- Data Processing: Village level boundaries were collected from ASSAC (Assam State Space Application Centre) was used to demarcate the extract extent of the flood prone areas in Jorhat district.
- Demographic data were integrated into the GIS database using village names as identifiers.
- The DEM (Digital Elevation Model) was analyzed in Arc GIS software to identify the different high and low lying zones of the study area.
- Spatial Correlation Analysis: In this section overlay analysis was performed between demographic data and frequent flood prone areas.
- Vulnerability Index Analysis (VIA) was computed using a weighted approach that considers households (40%), total population (40%), and Child population (20%) of the top 10 vulnerable villages.

### 3.3 Vulnerability Index Analysis:

A simple composite vulnerability index analysis was performed to rank villages by relative demographic vulnerability to floods. Chosen input variables and weights (based on vulnerability importance and data availability):

- Total Households (THH) — weight 0.40 (40%)
- Total Population (TP) — weight 0.40 (40%)
- Child population (0–6 yrs) — weight 0.20 (20%)
- Weights sum = 0.4 + 0.4 + 0.2 = 1.0.

We used min–max style normalization against the observed maxima (i.e., each variable divided by its maximum value in the dataset) so each component is scaled to [0, 1] before weighting and summation.

## 4. Results and Discussion

### 4.1 Demographic Profile of Flood-Affected Villages

10 villages have been surveyed for the study. Villages such as No.2 Kawoimari Gaon (3,759 people), Kolbari (2,447 people) and Bahfalla Gaon (2,436 people) stand out for their large populations and high household numbers. Child population (0–6 years), a key vulnerability indicator, is notably high in No.2 Kawoimari Gaon (444), Kolbari (375) and Bahfalla Gaon (364).

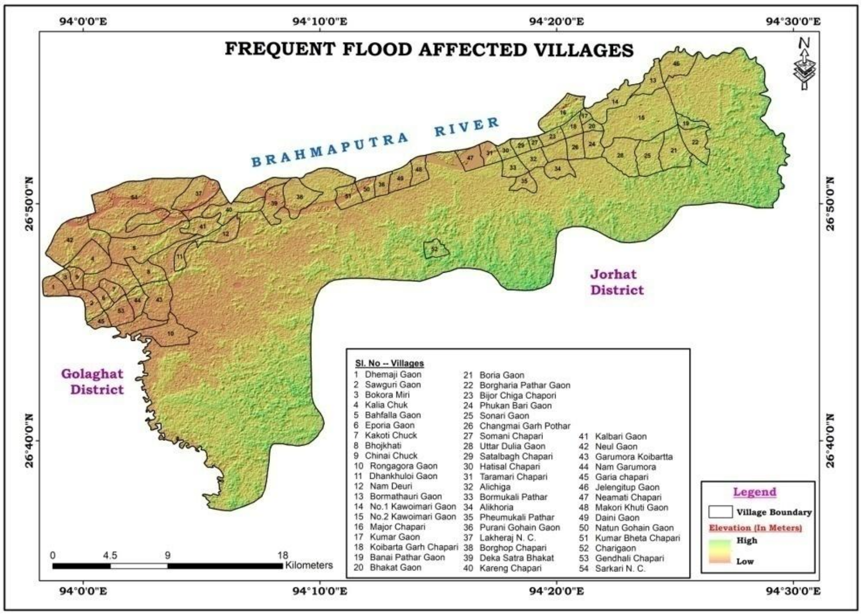


**Figure 2:** Frequent flood affected villages in Jorhat district

### 4.2 Flood Hazard Zonation

GIS-based flood hazard maps revealed three primary flood risk zones:

a) ***High Risk Zone:*** Low elevation (<55 m), proximity to the Brahmaputra or tributaries, annual flood recurrence.
b) ***Moderate Risk Zone***: Slightly higher elevation but subject to overbank flooding during peak discharge.
c) ***Low Risk Zone***: Elevated settlements with less direct river influence.

Villages in NW Jorhat and Kaliapani blocks predominantly fall within high and moderate risk zones.

### 4.3 Spatial Correlation Findings

High-risk demographic clusters are spatially aligned along the Brahmaputra floodplain and adjacent to distributaries channels.

### 4.4 Implications for Disaster Management

The concentration of large, young populations in high flood hazard zones underscores the need for prioritized evacuation planning, flood-resilient housing, and livelihood diversification programs.

## 5. Vulnerability Index Analysis

The Vulnerability Index analysis, based on weighted contributions from Total households (40%), Total population (40%) and child population aged between 0–6 years (20%), revealed that villages such as No.2 Kawoimari Gaon (1.00), Kolbari (0.61) and Bahfalla Gaon (0.60) exhibit the highest vulnerability due to their large household numbers, high population density and significant child dependency ratios. Moderate vulnerability was observed in villages like Gorumara Kaibartta (0.53) and Bormathauri Gaon (0.43), while sparsely populated villages such as Borghop Chapari and Neemati Chapari showed low vulnerability scores. Spatially, the most vulnerable settlements are concentrated along the Brahmaputra floodplain and its distributary channels, predominantly within North-West Jorhat and Kaliapani blocks, indicating the need for targeted flood risk reduction measures in these areas.

**Table 1:** Showing the Top Ten Vulnerable Villages in Jorhat District

| Village | Household | Population | Child Population (0-6) | Vulnerability Index |
|---|---|---|---|---|
| No.2 Kawoimari Gaon | 848 | 3759 | 444 | 1.00 |
| Kolbari | 385 | 2447 | 375 | 0.61 |
| Bahfalla Gaon | 371 | 2436 | 364 | 0.60 |
| Gorumara Kaibartta | 452 | 2086 | 212 | 0.53 |
| Bormathauri Gaon | 246 | 1728 | 282 | 0.43 |
| Jelengitoop Gaon | 338 | 1615 | 205 | 0.42 |
| Kareng Chapari | 255 | 1500 | 265 | 0.40 |
| Kalia Chuk | 232 | 1464 | 238 | 0.37 |
| Boria Gaon | 848 | 1512 | 116 | 0.37 |
| Neul Gaon | 385 | 1466 | 247 | 0.37 |

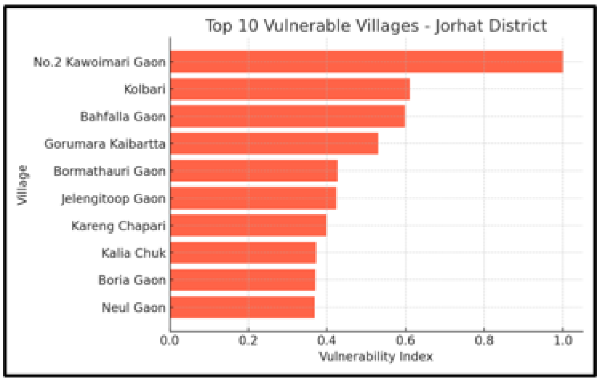


**Figure 3:** Top 10 Vulnerable Villages in Jorhat District

## 6. Recommendation

Nature-Based Solutions (NBS) offer an environmentally sustainable and cost-effective approach to reducing flood risks in the highly flood-prone areas of Jorhat district. The district's low-lying topography, proximity to the Brahmaputra River and high population density—particularly in villages such as No.2 Kawaimari Gaon, Kolbari and Bahfalla Gaon—contribute to its vulnerability. Effective strategies include creating riparian buffer zones with vegetation along riverbanks to control erosion, trap sediments and slow floodwaters; restoring floodplains in selected low-lying agricultural areas to improve water retention and reduce downstream flooding and strengthening embankments by planting deep-rooted native species such as bamboo, vetiver grass and indigenous trees to reduce the risk of breaches. Conserving wetlands can further enhance floodwater storage capacity and support local biodiversity, while promoting agro-forestry systems in vulnerable zones can help stabilize soil, provide alternative income sources and reduce flood impacts. In addition to these ecological measures, establishing early warning systems for high-risk villages, conducting community-based flood preparedness programs with special attention to vulnerable age groups and integrating geospatial datasets into the District Disaster Management Information System (DDMIS) can support continuous flood risk monitoring and strengthen disaster resilience.

## 7. Conclusion

The findings reveal a clear link between demographic density and flood exposure in Jorhat district. High population density, large household counts, and high child populations are predominantly located in areas with frequent inundation. GIS-based integration of demographic and hazard data provides a powerful tool for disaster risk reduction planning.

## References

[1] Adger, W. N. (2006). Vulnerability. Global Environmental Change,16(3),268-281
[2] Barbier, E.B. (2013). Valuing Ecosystem Services for Coastal Wetland Protection and Restoration: Progress and Challenges. Resources, 2(3), 213–230.
[3] Bhatta, L.D., Shrestha, H.L., Neupane, N., Shrestha, P., Hasnat, G.N.T., Ali, M., & Wagle, B.H. (2020). Nature-based solutions for agricultural water management and food security in the context of climate change. Journal of Environmental Management, 273, 111095.
[4] Cutter, S. L., Boruff, B. J. & Shirley, W. L., (2003). Social Vulnerability to Environmental Hazards. Social Science Quarterly, 84 (2), 242- 261
[5] FAO (2017). Nature-based solutions for agricultural water management and food security. Food and Agriculture Organization of the United Nations, Rome.
[6] IPCC (2007, 2014). Climate Change: Impacts, Adaptation, and Vulnerability. Intergovernmental Panel on Climate Change.
[7] NRSC (2016). Flood Hazard Zonation Atlas of India. National Remote Sensing Centre, Indian Space Research Organisation, Hyderabad.
[8] UNDRR (2019). Global Assessment Report on Disaster Risk Reduction. United Nations Office for Disaster Risk Reduction, Geneva.
[9] Vincent, K (2004) Creating an Index of Social Vulnerability to Climate Change for Africa.Tyndall Centre for Climate Change Research, Working Paper 56.