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SPATIAL INEQUALITIES IN BASIC SERVICE ACCESSIBILITY IN THE HIMALAYAN FOOTHILLS: A GEOSPATIAL ASSESSMENT OF SAMBA DISTRICT, J&K, INDIA

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Abstract

Equitable access to basic services like transport, law enforcement, healthcare, banking, and fire safety is a fundamental determinant of well-being and regional development, particularly in the ecologically fragile and topographically diverse tracts of the north-western Himalayan foothills. This study presents a geospatial assessment of the spatial distribution and accessibility of six categories of basic amenities including bus stops, police stations, primary health centres (PHCs), Jammu & Kashmir (J&K) Bank branches, fire stations, and HDFC Bank ATMs — across Samba district, Jammu Province, India. Locations of 56 individual facilities were geo-tagged using GPS-referenced coordinates and mapped in ArcGIS. Euclidean buffer-zone analysis was performed around police stations, primary health centres, and fire stations to delineate service-coverage envelopes, and the resulting layers were overlaid on a Land Use/Land Cover (LULC) classification of the district to evaluate accessibility in relation to settlement pattern and terrain. The results show a pronounced core–periphery gradient: amenities cluster along the National Highway corridor and around the twin industrial-urban nodes of Samba town and Bari Brahmana, while the northern hill tracts (Purmandal, Uttervani, Nud) and the southern border belt adjoining Pakistan remain comparatively underserved, with wider buffer gaps for emergency-response facilities. Of the district's 17 primary health centres, only two fire stations (three sub-units) and six police stations exist, a facility-to-area ratio that leaves large tracts beyond a reasonable emergency-response radius. The findings echo wider evidence from the Himalayan region that low-lying, well-connected plains areas enjoy lower vulnerability and better service access than remote and hilly tracts, and they underscore the need for terrain-sensitive, equity-oriented planning of public infrastructure. The study offers a replicable GIS-based framework for identifying service-accessibility gaps and provides an evidence base for future facility siting in Samba district and comparable sub-montane regions of the Himalaya.

Keywords: ***GIS, Basic amenities, Spatial accessibility, Buffer analysis, Land use-land cover, Samba district, Himalayan foothills, Service equity.***

Introduction

Geography and Geographic Information Systems (GIS) are intimately linked in contemporary spatial science. Geography, as the study of the Earth's physical features, environments, and human populations, supplies the conceptual foundation for understanding spatial relationships, while GIS supplies the computational apparatus like the capture, storage, analysis, and visualisation of geo-referenced data —

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that turns that understanding into actionable, mappable evidence (Goodchild, 2010). The convergence of the two disciplines has transformed the way researchers and planners examine land use, environmental change, urban growth, disaster risk, and, as in the present study, the spatial provisioning of basic public services.

Access to basic amenities like public transport, law-enforcement infrastructure, primary healthcare, banking, and fire-emergency response — is widely recognised as a proximate determinant of quality of life, economic opportunity, and resilience to shocks (Mitchell, 2020; Turner et al., 2021). Where such facilities are absent or poorly distributed, the burden falls disproportionately on populations in remote, hilly, or otherwise peripheral locations, reproducing what geographers term 'spatial inequality' — a systematic mismatch between where people live and where essential services are located (Bhatia & Singh, 2016; Singh & Singh, 2018). This mismatch is especially acute in mountainous and sub-montane regions, where difficult terrain, dispersed settlement, and seasonal connectivity constraints compound the effects of uneven infrastructure investment (Kumar et al., 2021; Romshoo et al., 2020).

GIS-based amenity mapping has therefore become an established methodology for diagnosing such disparities. By integrating heterogeneous data sources including census returns, topographic sheets, satellite and Google Earth imagery, and field-verified coordinates into a single spatial database, GIS enables researchers to (i) visualise the precise location of individual facilities, (ii) quantify the area and population served by each facility through buffer and network analysis, and (iii) relate service coverage to land use and settlement patterns, thereby generating an evidence base for equitable resource allocation (Johnson, 2010; Kumar, 2016; Nguyen, 2017). Comparable indicator- and GIS-based approaches have been used extensively in the Himalayan context to assess livelihood and infrastructural vulnerability, most notably the district-level Livelihood Vulnerability Index (LVI) framework applied across Jammu Province, which found that mountainous and remote districts such as Ramban and Kishtwar are considerably more vulnerable to climatic and infrastructural stress than the low-lying, well-connected districts of Jammu and Samba (Ahmad et al., 2023; Hahn et al., 2009). That province-level finding provides an important point of departure for the present, more granular, district-level investigation: if plains districts are the 'least vulnerable' at the provincial scale, it remains important to ask whether basic-service provisioning is itself spatially even within such a district, or whether pockets of the same relative disadvantage persist internally.

Samba district created in 2007 out of the erstwhile Jammu district and located on the sub-Himalayan foothills of the Shivalik range , offers a useful setting for this question. It combines a highly connected, industrialised core along the Jammu–Pathankot National Highway with a dispersed rural and semi-hilly periphery, and its administrative amenities have not previously been mapped and analysed in a systematic GIS framework. This paper therefore undertakes a geospatial inventory and accessibility assessment of six categories of basic amenities in Samba district which includes bus stops, police stations, primary health centres, J&K Bank branches, fire stations, and HDFC Bank ATMs by using Geospatial techniques like geo-tagging, Euclidean buffer analysis, and Land Use/Land Cover (LULC) overlay in ArcGIS systems.

Objectives

The study is guided by two specific objectives:

(a) To identify and map the precise location of basic amenities — bus stops, police stations, primary health centres, J&K Bank branches, fire stations, and HDFC Bank ATMs in Samba district using GIS; and

(b) To assess present accessibility patterns through buffer-zone and land use/land cover analysis, and on this basis to suggest future projections and priority locations for the augmentation of basic amenities in the district.

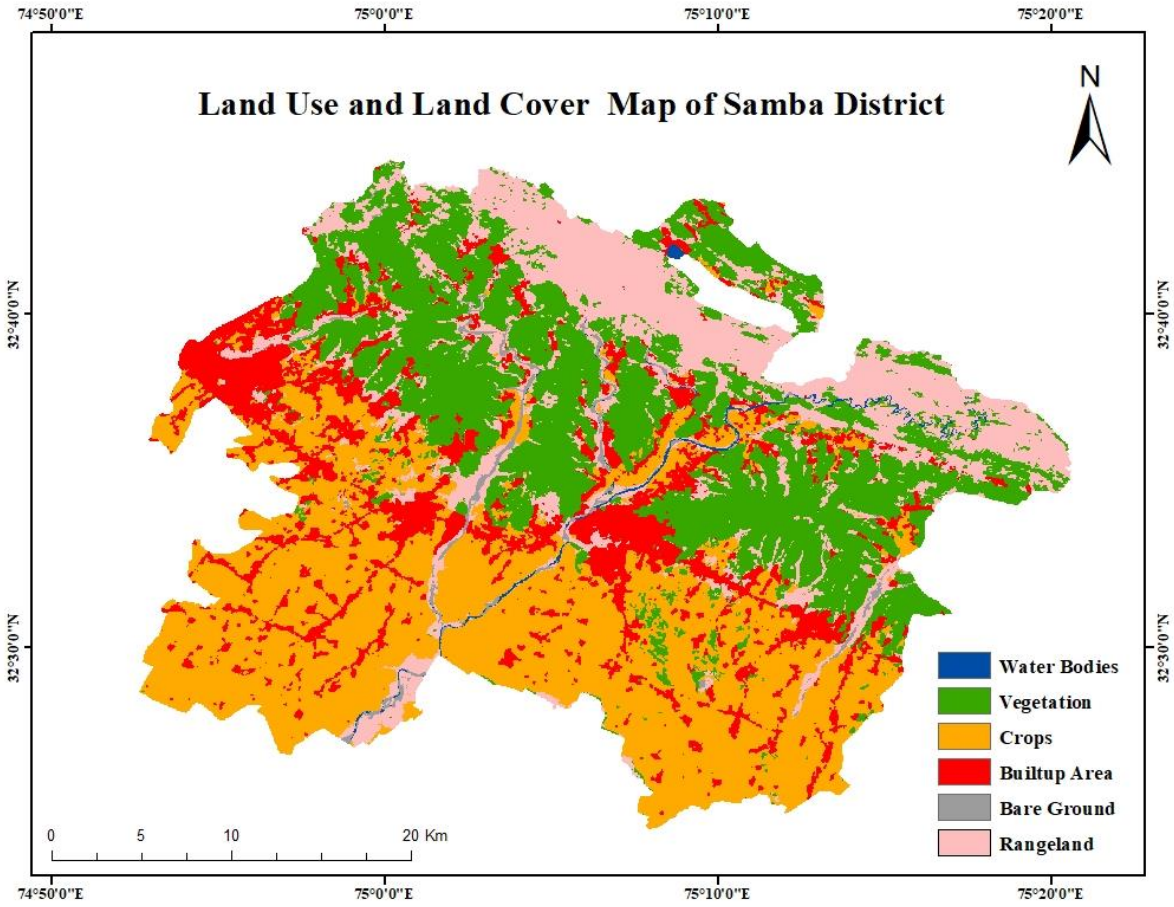
Study Area

Samba district lies in the southern part of the Jammu Province of the Union Territory of Jammu & Kashmir, centred approximately at 32.57° N latitude and 75.11° E longitude, with Samba town itself situated at an elevation of 384 m (1,259 ft) above mean sea level on the bank of the Basantar River, roughly 40 km east of Jammu city along National Highway 44. The district is bounded by Udhampur district to the north, Kathua district to the east, Tehsil Jammu and Bishnah (District Jammu) to the west, and by a 55.5 km stretch of the International Border with Pakistan to the south (Hussain, 2015).

Physiographically, Samba occupies the transition zone between the Shivalik (outer) Himalaya and the alluvial plains of the Punjab, and is drained by two principal rivers, the Basantar, a tributary of the Ravi, on whose bank Samba town stands, and the Devak (or Devika), a tributary of the Ujh, which flows partly as a sub-surface stream except during the monsoon and is locally revered as the 'Gupta Ganga'. The climate is sub-tropical i.e., hot and dry in summer and cold in winter, with recorded temperatures ranging between 6 °C and 47 °C tempered slightly by cooler nights typical of the Shivalik foothills.

Economically, Samba is among the more industrialised districts of the Union Territory. Two Industrial Growth Centres like at Bari Brahmana and at Samba which anchor the district's secondary sector: the Bari Brahmana Industrial Estate hosts around 250 industrial units with a cumulative investment of approximately ₹1,750 crore, while the Samba Industrial Growth Centre (Phases I and II), spread over 3,904 Kanal 18 Marla with a further 2,763 Kanal 2 Marla planned, hosts 242 units with an investment of about ₹684.79 crore. According to the 2011 Census of India, Samba district had a total population of 316,449 (approximately 3.16 lakh), comprising 1.66 lakh males and 1.50 lakh females, giving a sex ratio of 886 females per 1,000 males — the tenth lowest among districts of Jammu & Kashmir. The population is overwhelmingly rural: 2.25 lakh persons (83.07 per cent) live in rural areas against 0.54 lakh (16.93 per cent) in urban centres. Population density stands at 353 persons per km², the seventh highest in the Union Territory, and literacy is comparatively high at 82.48 per cent. Scheduled Castes constitute 28.84 per cent of the population, while Scheduled Tribes principally the Gujjar and Bakerwal pastoral communities

make up 5.64 per cent (Census of India, 2011.



Map 1. Land Use and Land Cover (LULC) of Samba District, Jammu Province, India
Source: Project field survey and ArcGIS analysis, 2023

Materials and Methods

Database

The study draws on a combination of secondary spatial and statistical sources supplemented by field-based geo-tagging. Specifically:

(i) Survey of India topographical sheets were used to establish the base geographic framework of the district;

(ii) Recent high-resolution imagery accessed through Google Earth was used to visually verify and geo-reference facility locations;

(iii) Demographic and socio-economic attributes were sourced from the Census of India (2011) and the Regional Digest of Statistics, Jammu Division; and

(iv) Point-location (latitude–longitude) data for 56 individual facilities across six amenity categories — bus stops (10), police stations (6), primary health centres (17), J&K Bank branches (13), fire stations (3, at two sites), and HDFC Bank ATMs (7) were compiled through field verification and geotaging.

Methodology

Research methodology, in the sense used here, denotes the systematic set of procedures through which the study's objectives were operationalised (Baskerville, 1991; Irny & Rose, 2005). The workflow followed six sequential stages, adapted from standard GIS facility-mapping procedures (Johnson, 2010; Robinson, 2019):

Step 1 – Data gathering: compilation of location information for each amenity category from field verification, secondary records, and imagery.

Step 2 – Data preparation: cleaning, standardising, and structuring the attribute data (facility name, category, coordinates) for import into a GIS environment.

Step 3 – Map creation: construction of a base map of Samba district in ArcGIS 10.x, onto which each amenity category was added as a discrete point layer.

Step 4 – Geo-tagging: assignment of precise geographic coordinates (decimal degrees, WGS-84) to each facility, using GPS field readings cross-checked against geocoded addresses.

Step 5 – Spatial (buffer) analysis: generation of Euclidean buffer zones around emergency-critical facilities — police stations, primary health centres, and fire stations — to delineate approximate service-coverage envelopes and identify coverage gaps.

Step 6 – Visualisation and overlay: preparation of thematic point maps, buffer maps, and a Land Use/Land Cover (LULC) overlay for each amenity category, enabling a combined reading of facility location, service coverage, and underlying land use/settlement context.

All maps were produced in ArcGIS using a consistent geographic coordinate system (GCS WGS-1984) to ensure comparability across layers. Buffer distances were held constant within each facility category so that the resulting zones are directly comparable across the district; areas falling outside all buffers for a given category are interpreted as under-served with respect to that service.

Results: Basic Amenities in Samba District

Mapping basic amenities involves the strategic placement and spatial analysis of facilities that serve the immediate needs of residents, commuters, and visitors. In Samba district six categories were examined — bus stops, police stations, primary health centres, J&K Bank branches, fire stations, and HDFC Bank ATMs — each with a distinct bearing on public safety, mobility, health, and financial inclusion. Strategically located police and fire stations shorten emergency-response times; well-distributed primary health centres extend the reach of essential healthcare; and a dense banking network, spanning both J&K Bank branches and HDFC ATMs, underpins financial inclusion and local economic activity. The sub-sections below present the geo-tagged inventory, spatial pattern, and (where applicable) buffer-coverage analysis for each category.

Spatial Distribution of Bus Stops

Ten principal bus stops/stands were geo-tagged across the district (Table 1; Fig. 1). The pattern shows a marked concentration around Samba town itself — the General Bus Stand, Local Bus Stop, and New Bus Stand together form a compact transport core — supplemented by peripheral nodes at Vijaypur, Ghagwal, Rajpura, Nud, Purmandal, Mansar More, and Sarore Nehar. The Mansar More stop, positioned close to the well-known Mansar Lake, doubles as a tourist-access point, while Ghagwal, Purmandal, and Nud extend public-transport connectivity into the district's more rural and hilly margins. The clustering of stands in and around Samba town confirms its role as the primary transportation hub of the district, from which radial routes extend to secondary and rural settlements.

Table 1. Geo-referenced locations of bus stops in Samba district

Bus Stop / Stand	Latitude (°N)	Longitude (°E)
General Bus Stand, Samba	32.55	75.12
Local Bus Stop, Samba	32.56	75.11
New Bus Stand, Samba	32.56	75.12
Mansar More Bus Stop	32.57	75.09
Vijaypur Bus Stop	32.56	75.02
Sarore Nehar Bus Stop	32.62	74.92
Ghagwal Bus Stop	32.48	75.19
Purmandal Bus Stop	32.68	75.01
Rajpura Bus Stand	32.48	75.18
Nud Bus Stand	32.62	75.14

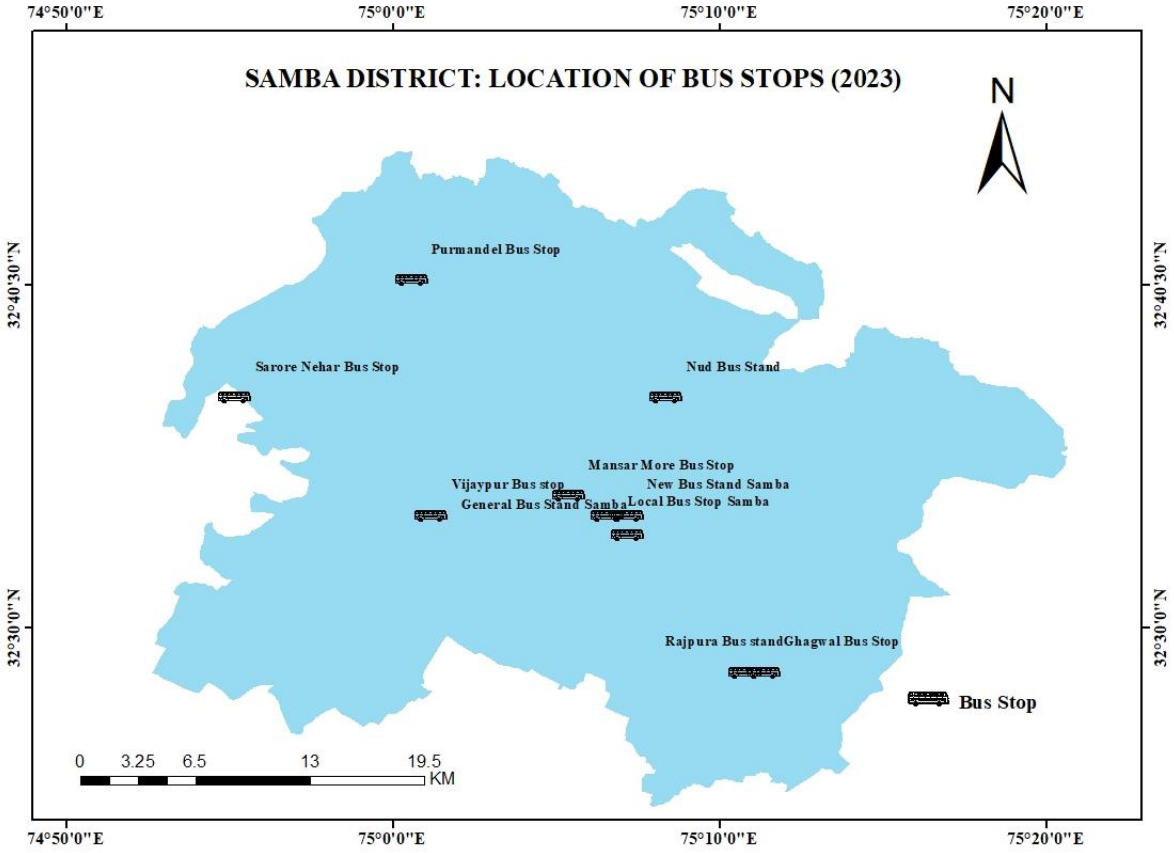


Fig. 1. Location map of bus stops in Samba district
Source: Field survey and ArcGIS analysis, 2023

Police Stations and Law-Enforcement Accessibility

Six police stations serve the district: Bari Brahmana, Ghagwal, Purmandal, Ramgarh, Samba, and Vijaypur (Table 2; Fig. 2). Their spatial arrangement shows a loose east–west and north–south spread,

with a discernible cluster — Bari Brahmana, Ghagwal, and Ramgarh — in the south-western part of the district and a second cluster — Samba and Vijaypur — in the central-southern belt, broadly tracking the alignment of the National Highway and the district's two main urban-industrial nodes. Purmandal, in the north, stands comparatively isolated, reflecting its role in covering the sparsely populated northern hill tract.

Table 2. Geo-referenced locations of police stations in Samba district

Police Station	Latitude (°N)	Longitude (°E)
Bari Brahmana	32.64	74.92
Ghagwal	32.51	75.21
Purmandal	32.69	75.05
Ramgarh	32.51	74.95
Samba	32.56	75.12
Vijaypur	32.58	75.02

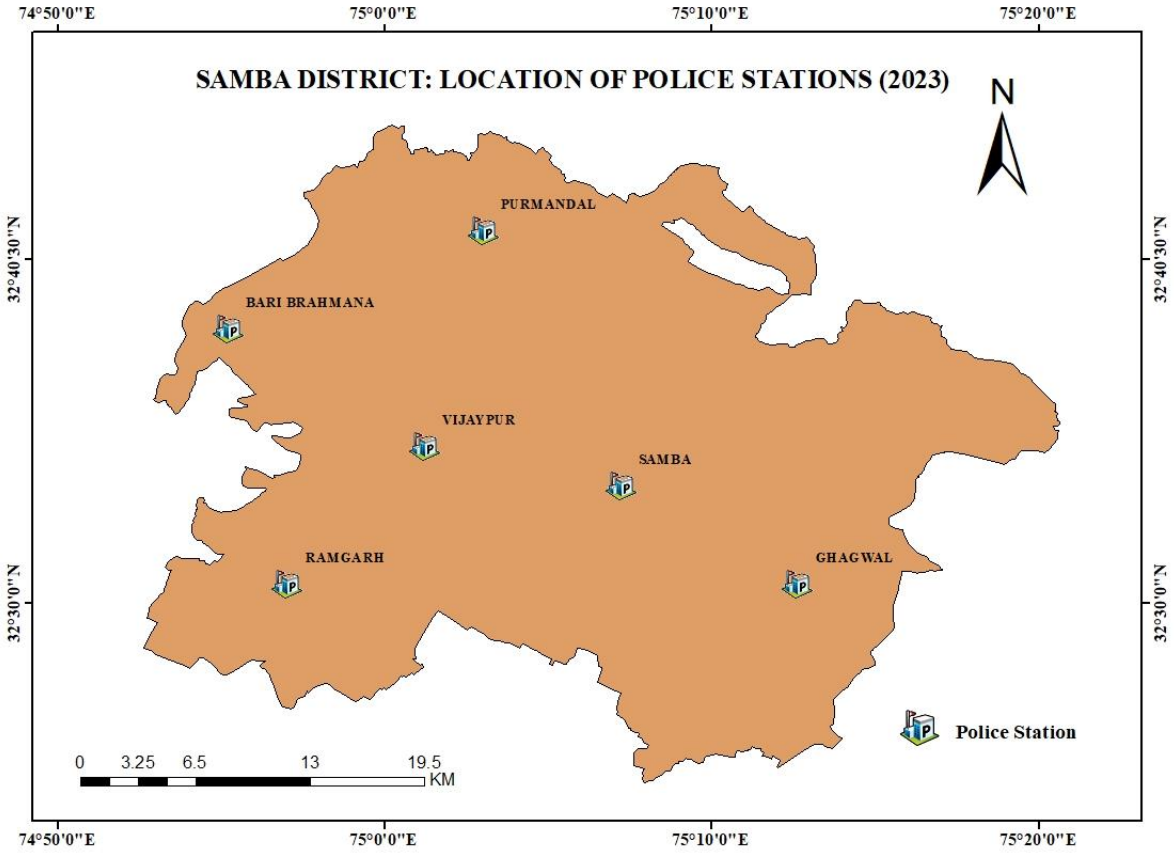


Fig. 2. Location map of police stations in Samba district
Source: Field survey and ArcGIS analysis, 2023

A Euclidean buffer analysis was performed around each police station to approximate its effective coverage envelope (Fig. 3). The buffer map shows reasonably continuous coverage along the highway corridor and around the twin urban nodes of Samba and Bari Brahmana, but visibly thinner coverage in the north (around Purmandal) and along stretches of the southern border belt, where the six-station network leaves gaps between buffer envelopes. These gap zones are candidate locations for future outposts or mobile policing units.

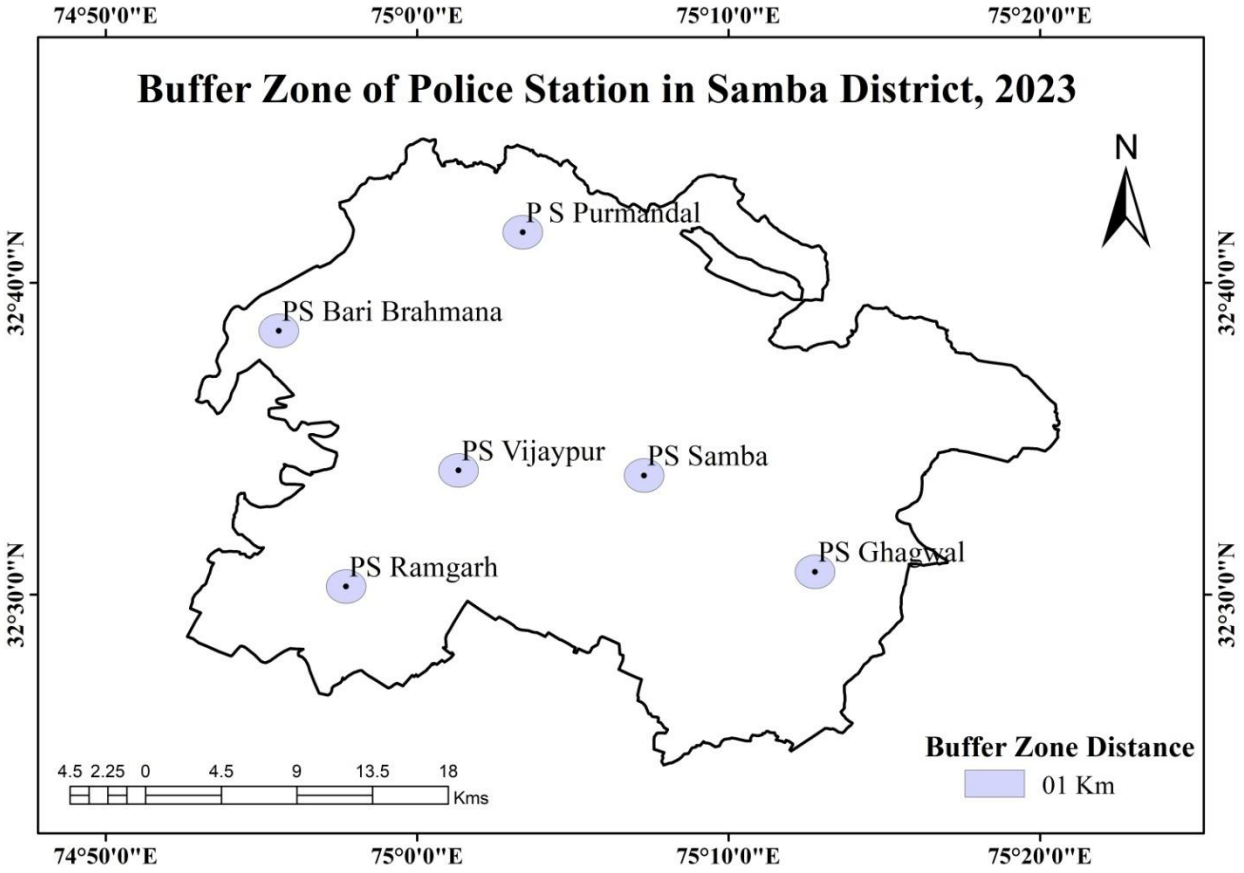


Fig. 3. Buffer-zone coverage of police stations, Samba district, 2023
Source: Field survey and ArcGIS analysis, 2023

Primary Health Centres and Healthcare Accessibility

Despite functioning as the district headquarters, Samba town itself has comparatively limited tertiary medical infrastructure; as reported by the Chief Medical Officer, a single district hospital operates from a government building in Samba town. Primary healthcare is instead delivered through a network of 17 Primary Health Centres (PHCs) distributed across the district — at Nud, Sumb, Dagore, Sanoora, Gurhaslathian, Nandpur, Ramgarh, Uttervani, Penthi, Mothian, Goran, Tarore, Jatwal, Sanghwal, Taloor, Barikhad, and Purmandal (Table 3; Fig. 4).

Table 3. Geo-referenced locations of Primary Health Centres (PHCs) in Samba district

Primary Health Centre	Latitude (°N)	Longitude (°E)
Nud	32.62391	75.15200
Sumb	32.60432	75.22606

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Primary Health Centre	Latitude (°N)	Longitude (°E)
Dagore	32.58707	75.07016
Sanoora	32.44670	75.14901
Gurhaslathian	32.59002	75.00563
Nandpur	32.51892	74.88968
Ramgarh	32.50810	74.96889
Uttervani	32.66178	74.95080
Penthi	32.59414	75.15297
Mothian	32.52185	75.18894
Goran	32.55634	75.23372
Tarore	32.60360	74.94383
Jatwal	32.54109	75.15492
Sanghwal	32.57542	74.97643
Taloor	32.61476	75.18603
Barikhad	32.58632	75.21056
Purmandal	32.68149	75.00853

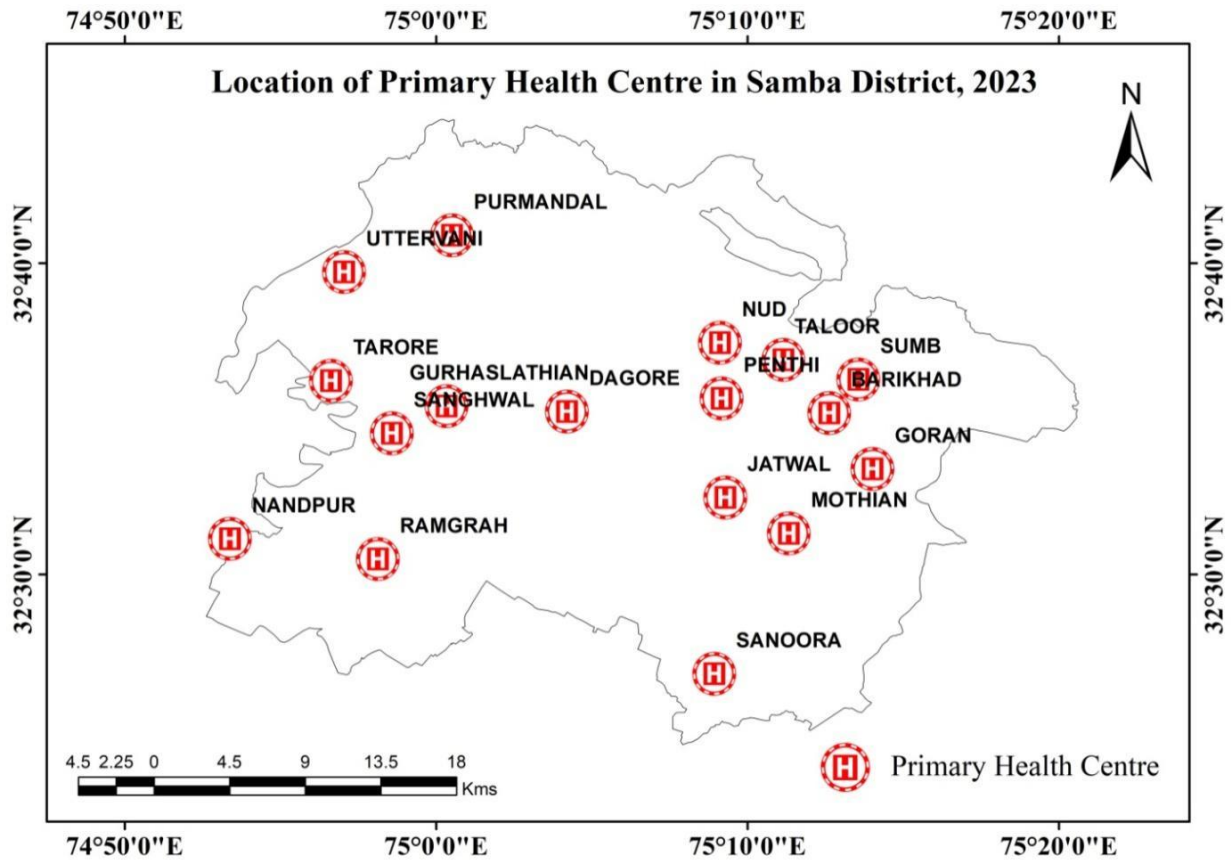

Fig. 4. Location map of Primary Health Centres in Samba district
Source: Field survey and ArcGIS analysis, 2023

PHCs show the most even areal spread of any amenity category examined, extending into hill and border tracts (Sanoora, Uttervani, Purmandal, Barikhad) that lack comparable police or fire coverage — a pattern consistent with the historical priority given to primary-healthcare outreach under national rural health programmes. The buffer-zone analysis (Fig. 5) indicates that most rural habitations fall within a reasonable service radius of at least one PHC, although effective accessibility in the hillier northern tracts is likely to be lower than the Euclidean buffer implies, since travel distance and time along the district's road network exceed straight-line distance in dissected terrain.

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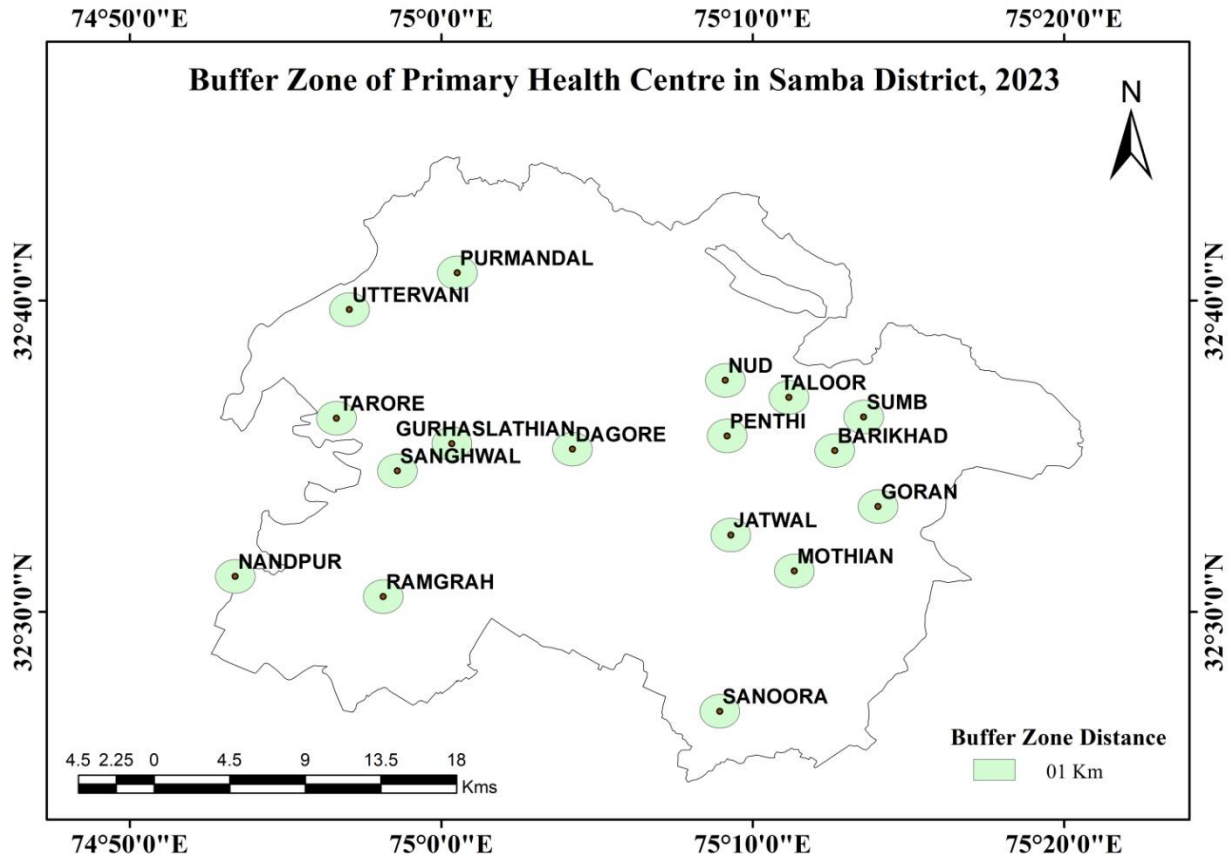

Fig. 5. Buffer-zone coverage of Primary Health Centres, Samba district, 2023
Source: Field survey and ArcGIS analysis, 2023

Banking Infrastructure: Jammu & Kashmir Bank Branches

Thirteen branches of the Jammu & Kashmir (J&K) Bank were geo-tagged (Table 4; Fig. 6): Birpur Narsingh Dev Ji, Gagwal, Jatwal, Nandani Hills, Nud (Samba), Patlimorh, Rahya, Rajpura, Ramgarh, Surara, Swankha, Vijaypur, and Bari Brahmana. The branch network extends from the eastern margin of the district (Birpur Narsingh Dev Ji) to its western edge (Surara), indicating a deliberate effort to serve both the industrial-urban core and the rural hinterland. Branches at Nud, Patlimorh, and Ramgarh coincide with the district's industrial and commercial zones, while branches such as Rahya and Jatwal, located further from the main urban centres, function as points of financial inclusion for otherwise underserved rural communities.

Table 4. Geo-referenced locations of J&K Bank branches in Samba district

J&K Bank Branch	Latitude (°N)	Longitude (°E)
Birpur Narsingh Dev Ji	32.56	75.12
Gagwal	32.51	75.21
Jatwal	32.53	75.17
Nandani Hills	32.56	75.08

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J&K Bank Branch	Latitude (°N)	Longitude (°E)
Nud, Samba	32.62	75.15
Patlimorh	32.60	74.94
Rahya	32.63	74.91
Rajpura	32.48	75.18
Ramgarh	32.50	74.96
Surara	32.50	75.22
Swankha	32.57	74.99
Vijaypur	32.57	75.01
Bari Brahmana	32.64	74.90

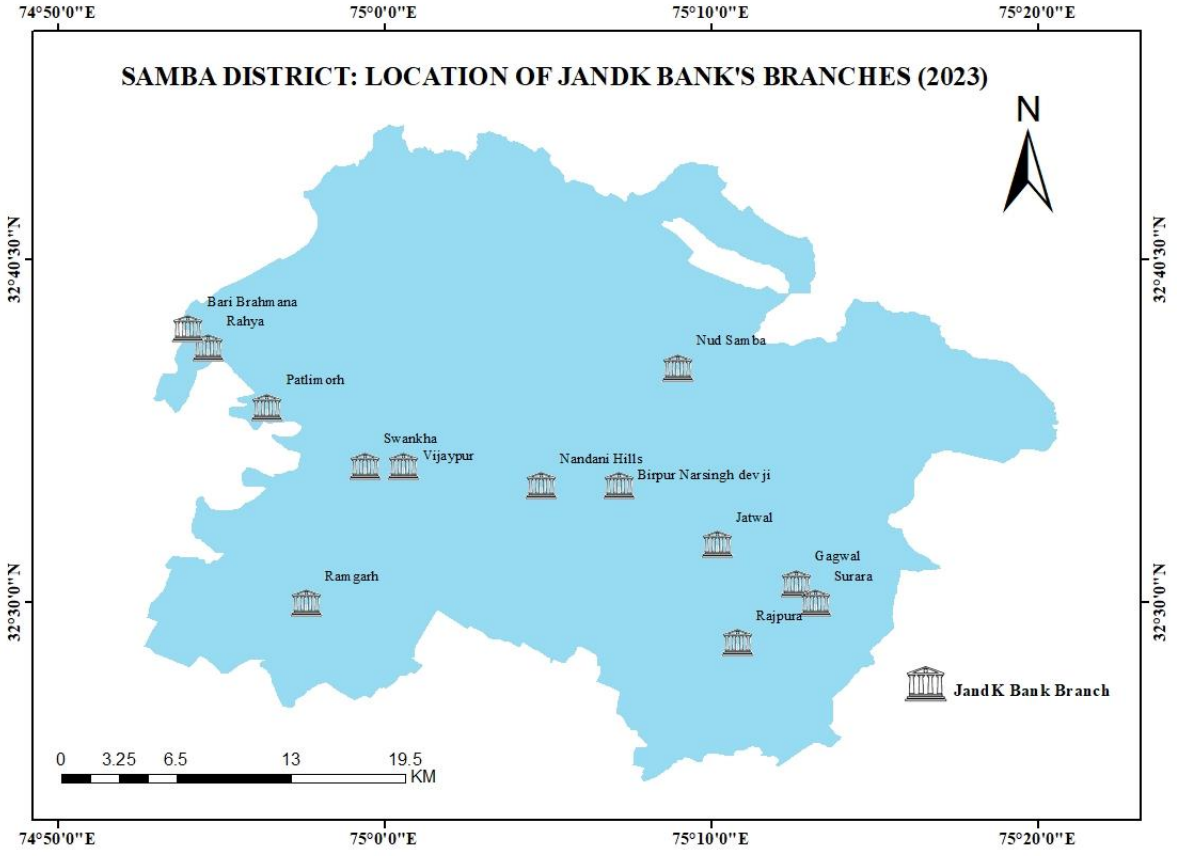

Fig. 6. Location map of J&K Bank branches in Samba district
Source: Field survey and ArcGIS analysis, 2023

Fire Stations and Emergency-Response Coverage

Fire-emergency infrastructure in Samba district is the thinnest of the six categories examined, comprising only two fire-station sites — two co-located units at Bari Brahmana and a single station at Samba town — for the entire district (Table 5; Fig. 7). The close spatial proximity of the two Bari Brahmana units

suggests a concerted effort to protect the district's largest industrial estate, where fire risk is elevated by the concentration of manufacturing units, while the Samba town station serves the administrative and commercial core to its east.

Table 5. Geo-referenced locations of fire stations in Samba district

Fire Station	Latitude (°N)	Longitude (°E)
Bari Brahmana – I	32.64	74.92
Bari Brahmana – II	32.63	74.91
Samba (town)	32.55	75.11

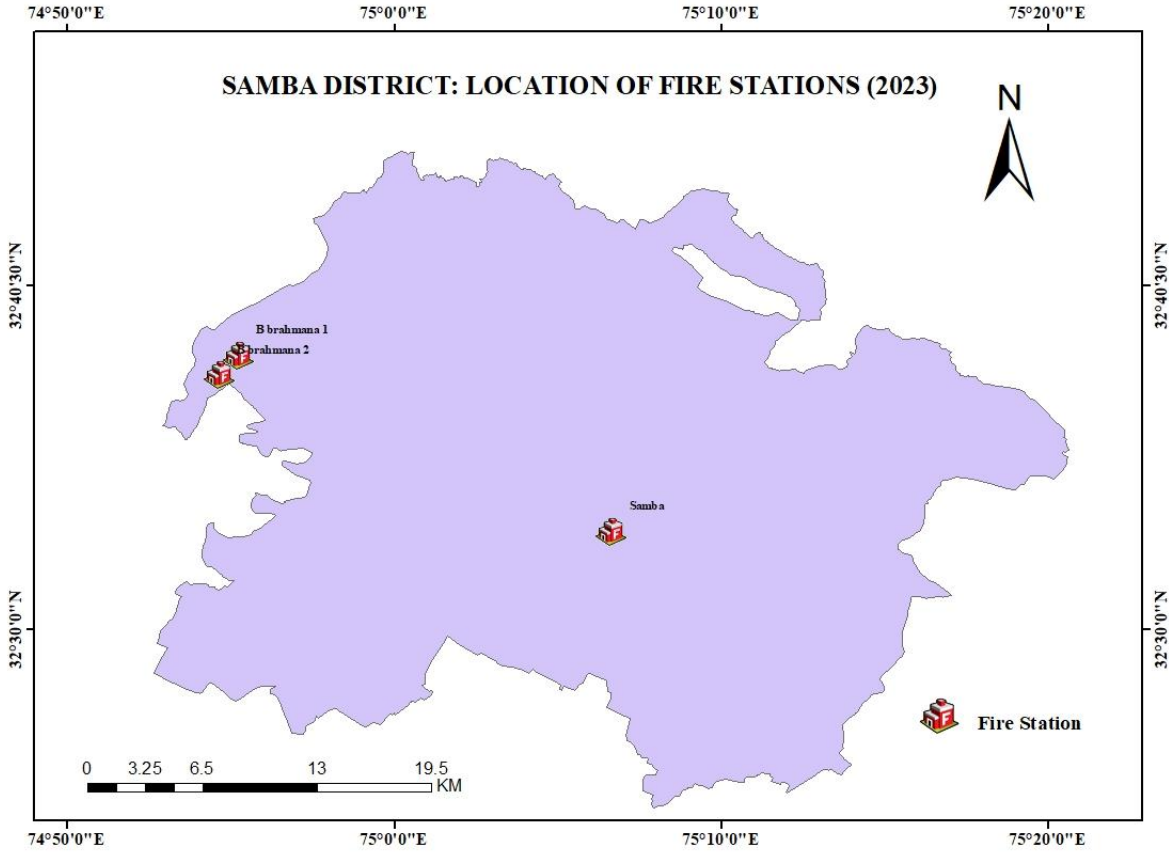

Fig. 7. Location map of fire stations in Samba district
Source: Field survey and ArcGIS analysis, 2023

The buffer-zone map for fire stations (Fig. 8) makes the resulting coverage gap explicit: with only two effective sites, large parts of the district — including the entire northern hill tract and much of the southern border belt — fall well outside a reasonable emergency-response buffer. This is the starkest accessibility deficit identified in the study and, given the fire risk associated with the district's industrial estates and dry-season agricultural land, represents the most urgent priority for future facility siting.

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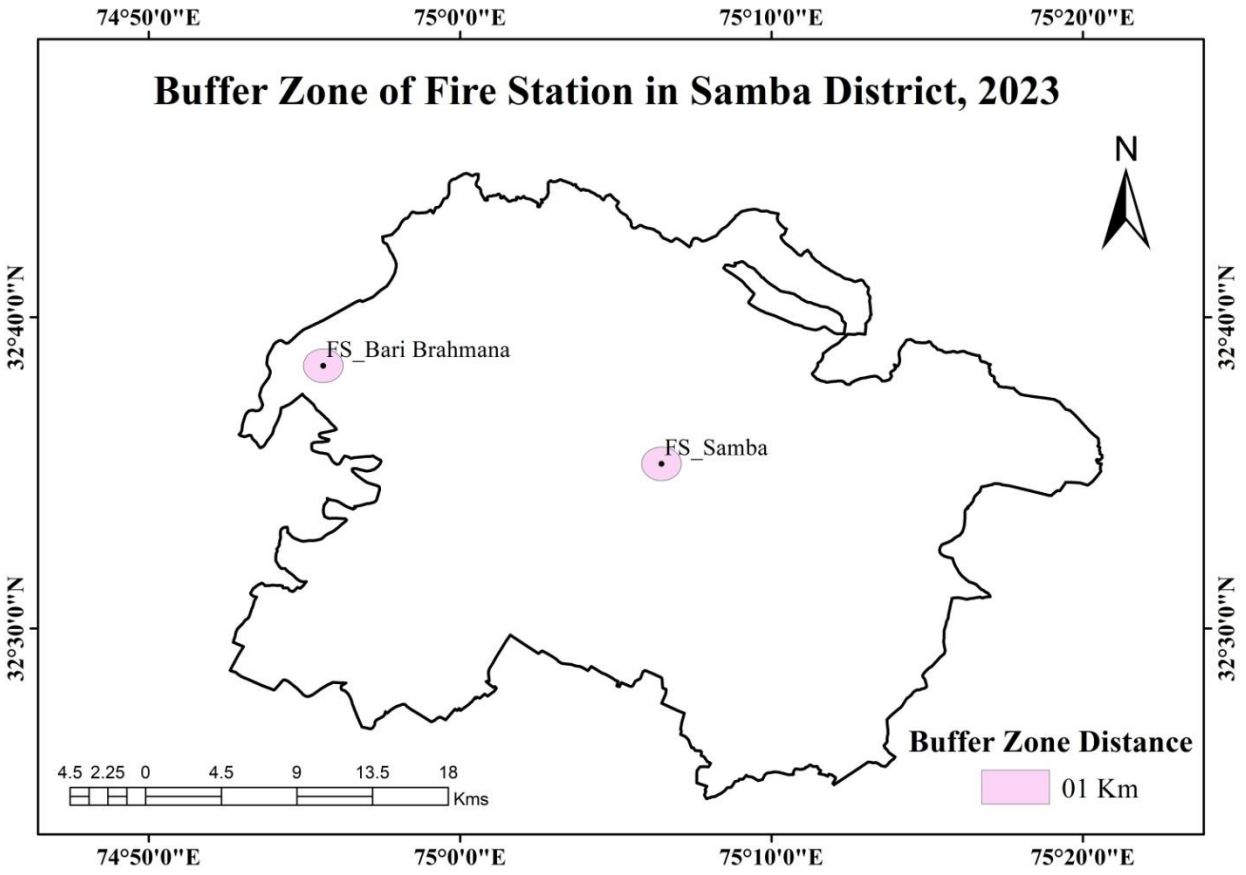

Fig. 8. Buffer-zone coverage of fire stations, Samba district, 2023
Source: Field survey and ArcGIS analysis, 2023

HDFC Bank ATMs and Complementary Financial Access

Seven HDFC Bank ATMs supplement the J&K Bank branch network, located at Vijaypur (offsite and city), Bari Brahmana, Samba (two units), and Ramgarh (two units) (Table 6; Fig. 9). The clustering of ATMs at Samba and Ramgarh, in particular, indicates a private-sector banking presence concentrated almost entirely within the industrial-urban corridor along the National Highway, with negligible penetration into the district's northern and southern peripheries — a pattern that contrasts with the wider, more rural-inclusive spread of the J&K Bank branch network described above.

Table 6. Geo-referenced locations of HDFC Bank ATMs in Samba district

HDFC Bank ATM	Latitude (°N)	Longitude (°E)
Vijaypur (Offsite)	32.57	75.00
Vijaypur City	32.56	75.02
Bari Brahmana	32.63	74.91
Samba – I	32.57	75.12
Samba – II	32.56	75.11
Ramgarh – I	32.55	74.99

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HDFC Bank ATM	Latitude (°N)	Longitude (°E)
Ramgarh – II	32.56	74.99

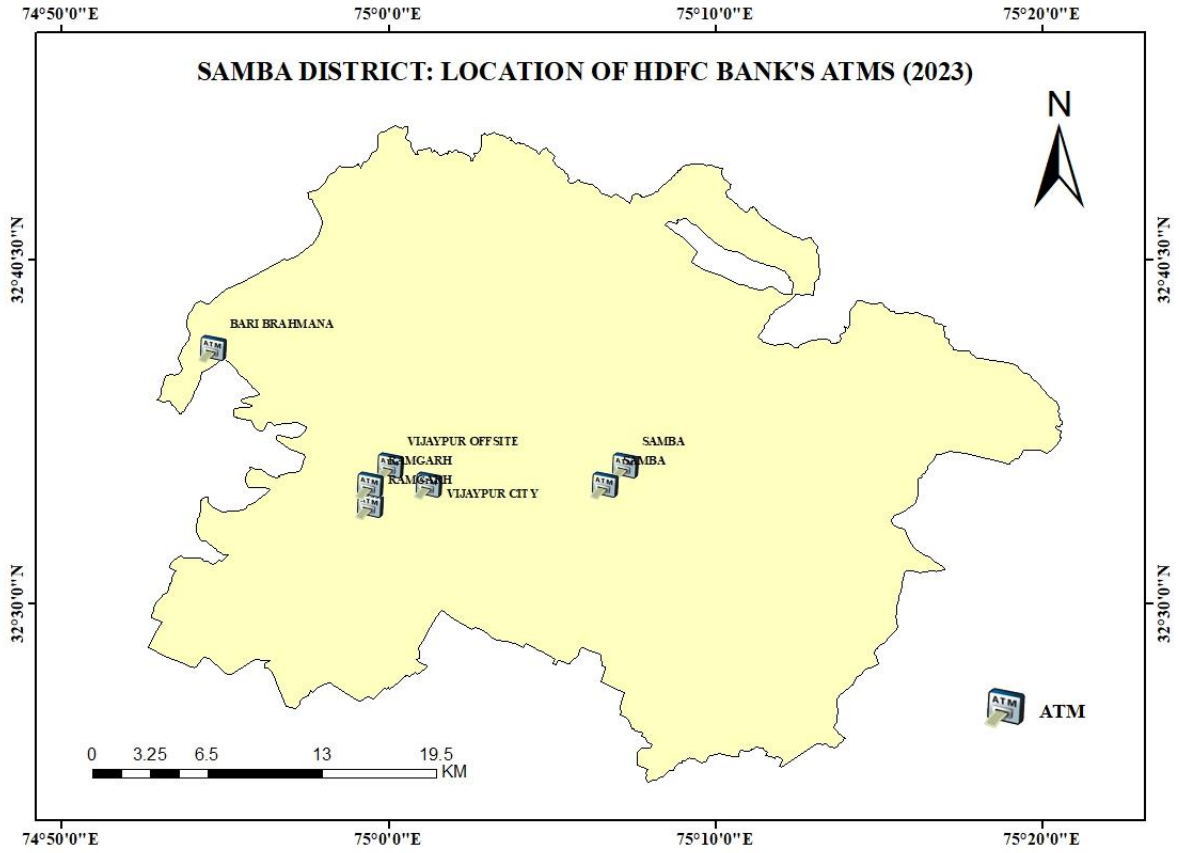

Fig. 9. Location map of HDFC Bank ATMs in Samba district
Source: Field survey and ArcGIS analysis, 2023

Land Use/Land Cover-Based Accessibility Assessment and Future Projections

To situate the point-location and buffer analyses within their physical-geographic context, the facility layers for primary health centres, fire stations, and police stations were overlaid on a Land Use/Land Cover (LULC) classification of Samba district prepared in ArcGIS (Fig. 10–12). The LULC overlay allows facility distribution to be read against the underlying pattern of built-up area, agricultural land, forest/hill cover, and water bodies, and thereby offers a more grounded basis for identifying genuine accessibility gaps than point or buffer maps alone.

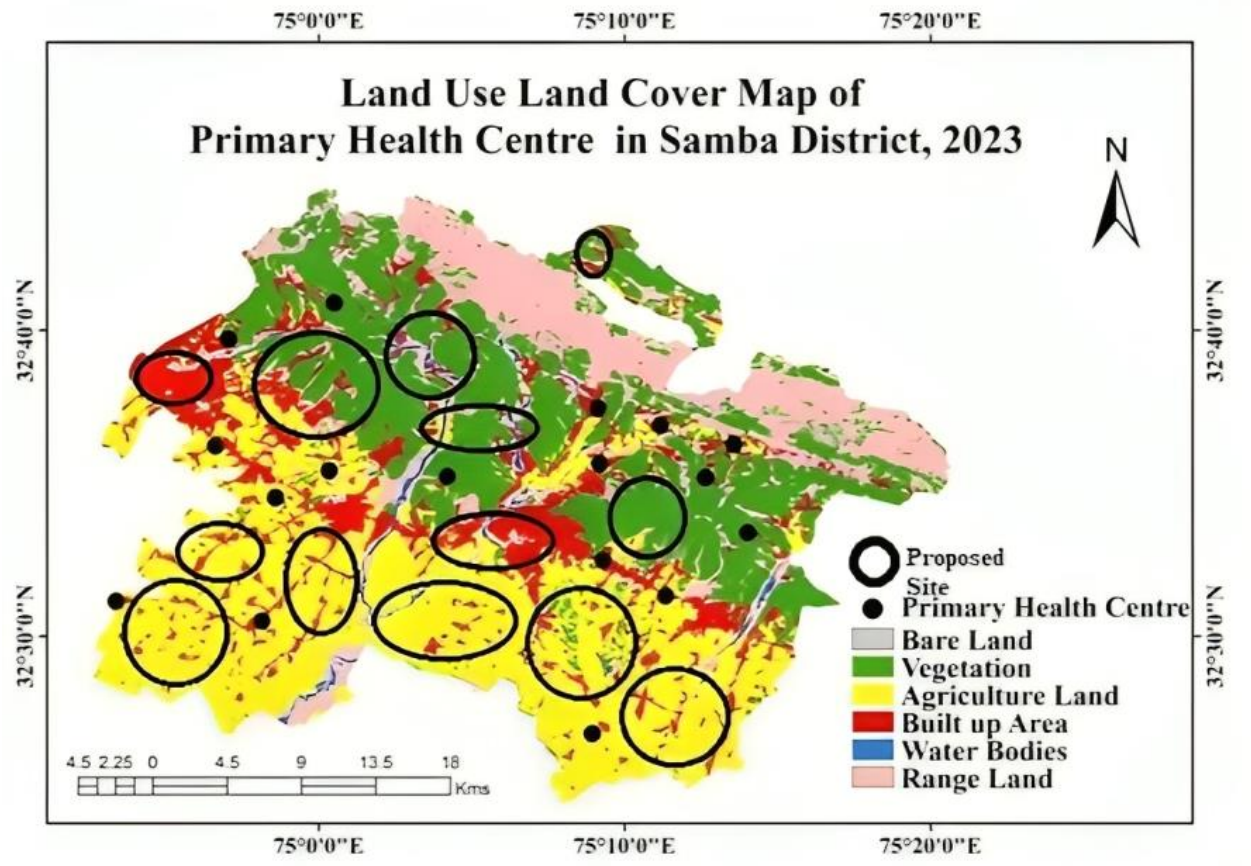

Fig. 10. LULC-based distribution of Primary Health Centres, Samba district, 2023
Source: Field survey and ArcGIS analysis, 2023

The LULC overlay for PHCs confirms that most centres are sited within or adjacent to agricultural and built-up land in the central and eastern parts of the district, with a thinner presence in forest-dominated tracts to the north. This is consistent with the settlement pattern of the district, where population is concentrated on cultivable and urbanised land, but it also implies that the forest-fringe and hill-margin population — including scattered Gujjar and Bakerwal habitations — face the longest effective travel distances to healthcare.

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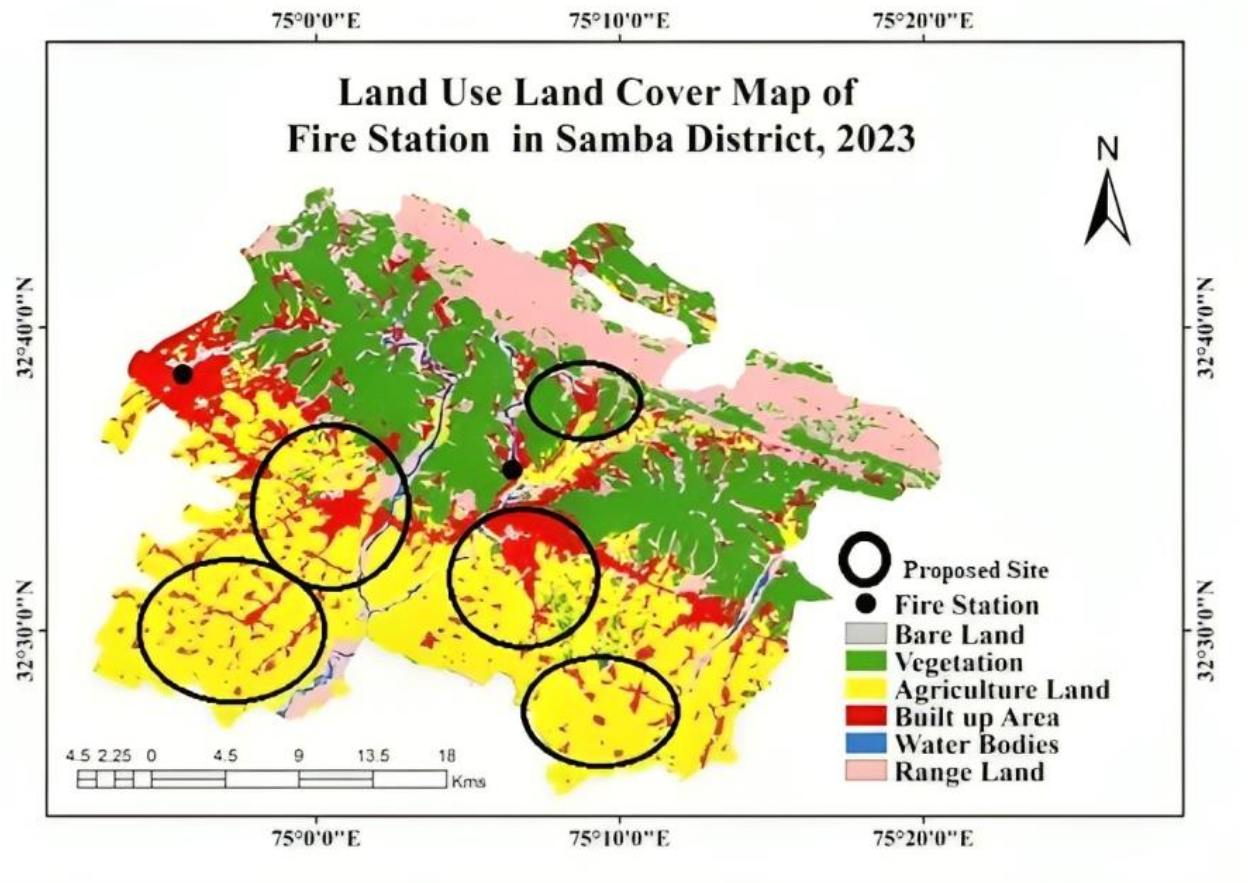

Fig. 11. LULC-based distribution of fire stations, Samba district, 2023
Source: Field survey and ArcGIS analysis, 2023

For fire stations, the LULC overlay reinforces the buffer analysis in Section 4.5: both facilities are located on built-up/industrial land in the southern part of the district, leaving the agricultural and forested northern and eastern tracts — and the industrial belt's own dry-season margins — without proximate coverage. Land-use change over time (e.g., expansion of built-up or industrial land) can be tracked against this baseline to inform the timing of future station additions.

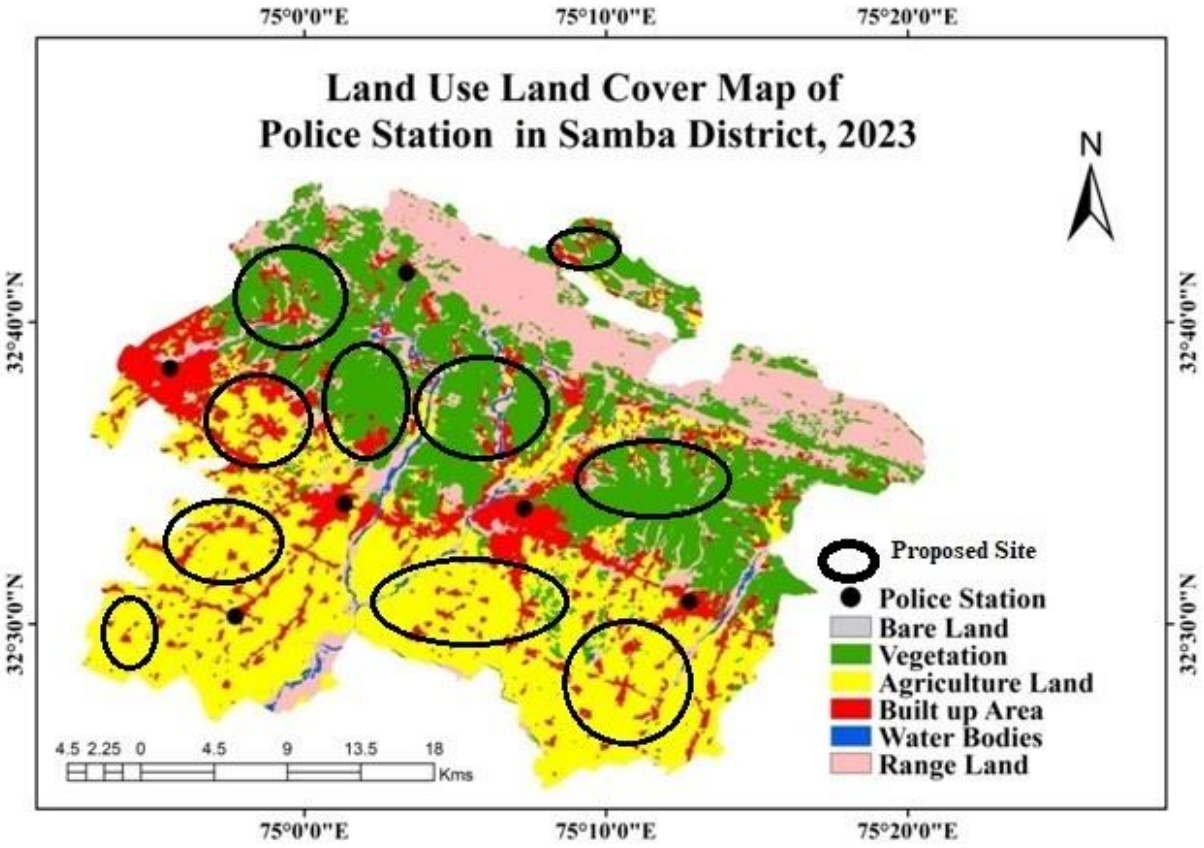

Fig. 12. LULC-based distribution of police stations, Samba district, 2023
Source: Field survey and ArcGIS analysis, 2023

The police-station overlay shows a similar, though less extreme, pattern: stations are concentrated on built-up and transport-corridor land, with comparatively sparse coverage of the district's forest and hill-margin land use classes. Read together, the three LULC overlays support a consistent inference — emergency and law-enforcement infrastructure in Samba district is oriented toward the built-up, industrial, and highway-adjacent land uses of the southern and central belt, while agricultural, forest, and hill-margin land uses in the north and along parts of the border belt remain comparatively under-served.

Future Projections for Facility Siting

On the basis of the buffer-coverage gaps and LULC overlays identified above, the following priority locations emerge for the future augmentation of basic amenities in Samba district:

- Fire services: a new station in the northern hill tract (in the vicinity of Purmandal/Uttervani) and a further unit along the southern border belt would substantially close the largest coverage gap identified in this study.
- Policing: an additional outpost or mobile policing unit between the Purmandal cluster and the Samba–Vijaypur cluster would reduce the north–south coverage gap evident in the police buffer map.
- Healthcare: while PHC coverage is comparatively even, upgrading selected hill-margin PHCs (e.g., Sanoora, Uttervani, Barikhad) toward Community Health Centre status would improve effective, road-network accessibility for the northern population.

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• Banking: extension of HDFC Bank ATM coverage — currently confined to the highway corridor — toward Purmandal and the border belt would complement the wider rural reach already achieved by J&K Bank branches.

Discussion

The geo-tagged inventory and buffer/LULC analysis converge on a single, consistent spatial pattern: basic amenities in Samba district are concentrated along the National Highway corridor and around the twin urban-industrial nodes of Samba town and Bari Brahmana, while the northern hill tracts and the southern border belt remain comparatively under-served. This pattern holds most strongly for the two emergency-critical categories with the sparsest facility networks — fire stations and, to a lesser extent, police stations — and is weakest for primary health centres, whose 17-facility network achieves the most even areal spread of the six categories examined. Banking infrastructure sits between these extremes: the state-owned J&K Bank network extends meaningfully into rural and peripheral settlements, whereas private-sector HDFC ATM placement is almost entirely confined to the highway-adjacent urban-industrial belt.

These findings are consistent with, and provide a finer-grained complement to, provincial-scale evidence on livelihood and infrastructural vulnerability in the wider Jammu region. Ahmad et al. (2023), applying a Livelihood Vulnerability Index across the ten districts of Jammu Province, found that Jammu district recorded the lowest vulnerability score in the province — attributed in part to strong infrastructure and favourable socio-economic conditions — while mountainous and remote districts such as Ramban and Kishtwar recorded the highest vulnerability, reflecting weak socio-economic infrastructure and difficult terrain. The present district-level analysis suggests that a structurally similar, if less extreme, core–periphery pattern operates within Samba district itself: its highway-adjacent, industrialised core resembles the low-vulnerability profile of Jammu district, while its northern hill margin and border belt exhibit the same underlying drivers of disadvantage — distance from urban centres, difficult terrain, and thinner infrastructure investment — that characterise the province's most vulnerable districts, albeit at a much smaller spatial scale.

The disparity is also consistent with the broader literature on infrastructure and service-access mapping, which repeatedly finds that peripheral and topographically constrained areas receive disproportionately less investment in emergency and financial infrastructure than well-connected urban cores (Bhatia & Singh, 2016; Mitchell, 2020; Turner et al., 2021). The particularly acute fire-service gap identified here is noteworthy given the concentration of industrial units at Bari Brahmana and Samba: a facility-to-area ratio of two sites for a district of Samba's size and industrial profile falls well short of the coverage that comparable Indian district-level emergency-planning norms would recommend, and it is an area where the geospatial evidence developed in this study can directly inform siting decisions.

Two methodological caveats merit note. First, the buffer analysis employed here is Euclidean (straight-line) rather than network-based; in the dissected, hilly terrain of northern Samba, actual road-network travel distances — and therefore real response times — will generally exceed the straight-line buffer radius, so the coverage gaps identified in this study should be read as conservative (i.e., minimum) estimates of the true accessibility deficit. Second, the amenity inventory, while comprehensive for the six categories examined, does not extend to educational institutions, water-supply infrastructure, or private healthcare providers; a fuller multi-sectoral accessibility index, following the composite indicator approach used in regional livelihood-vulnerability studies (Hahn et al., 2009; Sujakhu et al., 2019), would be a natural extension of the present work.

Conclusion and Policy Recommendations

This study has constructed a geo-tagged inventory of 56 basic-amenity facilities across six categories in Samba district and used ArcGIS-based buffer and land use/land cover analysis to assess their spatial coverage. The results demonstrate a clear core–periphery pattern: facilities cluster along the National Highway and around the Samba–Bari Brahmana industrial-urban corridor, while the northern hill tract and the southern border belt experience comparatively limited access, most severely for fire-emergency services and, to a lesser degree, for policing and private-sector banking (HDFC ATMs). Primary health centres show the most equitable spatial spread of the six categories, reflecting sustained investment in rural primary-healthcare outreach, though effective accessibility in hill-margin areas remains constrained by terrain.

These findings carry direct implications for district-level planning. Priority should be given to establishing at least one additional fire station in the northern hill tract and strengthening police presence between the Purmandal and Samba–Vijaypur clusters; upgrading selected hill-margin PHCs would improve effective, not merely nominal, healthcare access; and encouraging private-sector banking expansion beyond the highway corridor would complement the more rural-inclusive reach already achieved by the J&K Bank network. More broadly, the study demonstrates the value of a replicable, GIS-based geo-tagging and buffer/LULC framework for diagnosing basic-service accessibility gaps at the district scale — a framework that could be extended to other sub-montane districts of the Jammu Province and, with locally adapted amenity categories, to comparable Himalayan foothill regions elsewhere. Future research should incorporate network-based (rather than Euclidean) accessibility modelling, extend the amenity inventory to education and water-supply infrastructure, and integrate population-weighted demand data so that facility-siting recommendations can be prioritised not only by geographic coverage but by the number of residents they would newly serve.

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