



Rural-Urban Continuum and the Changing Geography of Service Accessibility in Dryland West Bengal: A Critical Literature Review

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ABSTRACT

One objective of this critical literature review is to examine the geospatial distribution of essential services along the rural-urban spectrum in dryland western West Bengal. It focuses on healthcare, education, markets, transport, digital and financial services, and rural development connectivity and how they manifest in villages, rural service centers, census towns, municipalities, and regional urban centers. This review incorporates a selective evidence-structuring and thematic-synthesis technique to integrate the foundation of geographical theory with international accessibility and Indian studies, and the limited literature on West Bengal. It has been shown that the presence of a service facility does not result in effective access. The interaction of several factors such as the centrality of the settlement, network friction, travel time, service sufficiency, affordability, institutional reliability, and individual and household capability, is equally important. The majority of small and intermediate settlements ease the travel time burden for lower order services, but the greater burden remains as individuals and households still travel to larger towns for higher order specialized services, staff, and transport. Various digital services may reduce certain types of travel burdens, however, the benefits of digital services remain dependent on a number of factors including social and financial support.

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The literature has progressed from facility enumeration and Euclidean distance measurement to network travel measurement, floating catchment areas, spatial proximity and clustering, and various indices; however, car-oriented thinking, limitations in transport capacity measurement, and lack of support for seasonal variations still dominate. Rural-urban continuum theory provides the spatial context in the integrated framework, accessibility theory provides the measurable relationships, and spatial justice provides the analysis of distribution of burdens and benefits in the framework, whilst regional development theory provides the explanation for uneven concentration and diffusion in the framework. A major area of research needed is a village-scale, multi-modal (including different forms of transport), and seasonally and capacity-adjusted assessment of cross-service accessibility relevant to the dryland area in the western part of the state.

1. Introduction and Problem Formulation

Geographical disparities in access to health, education, market, transport, communication, financial services and basic infrastructure are pronounced, not only between urban areas and rural areas, but also in the intermediary areas connecting the two. The main problem is that having a facility is not synonymous with having the ability or opportunity to reach and use it. Health facilities may be physically accessible but closed at night, schools may be within administrative distance but require traveling an unsafe distance, and banking services may be available but be out of cash and off-line. Therefore, accessibility is the result of a complex interplay of opportunities, networks, time, costs, service capacity and individual ability rather than a mere inventory of services (Geurs & van Wee, 2004; Páez et al., 2012).

The rural-urban continuum is an appropriate framing of this situation because many of the intermediary settlements are responsible for providing daily services to the surrounding areas. Gram-panchayat headquarters, market towns, block towns, census towns and small municipalities may comprise clinics, schools, banks, bus and digital services. These settlements may fulfill important services for surrounding rural areas, regardless of their administrative title or urban status. The absence of urban infrastructure does not signify the absence of urban functions. The continuum is better described as a set of morphological, functional, institutional and digital gradations than a linear progression from rural to urban (Pahl, 1966; Tacoli, 1998; UN-Habitat, 2019).



With regards to this review, dryland West Bengal mostly pertains to Purulia, Bankura, and Jhargram. Western Paschim Medinipur will be considered a transition zone. This is an analytical definition, not a definitive one. Settlements in the area are spread out and so are the resources. Factors such as seasonally available water and inadequate road networks do not cause deprivation on their own. That is mostly a function of transport, facilities, and public service maintenance. Research based in Bankura and block level studies in Paschim Medinipur suggest that the terrain and the concentration of institutions and settlements correspond with spatial inequality, although the evidence remains sector-based (Kanga et al., 2021; Kar & Bhunia, 2023).

While this literature review will focus primarily on rural development, the review will remain analytically separate from migration or employment-related studies. Mobility and changes in the economy will be discussed only in terms of service demand changes or journey and institution-related changes. Therefore, the focus will mostly be on the geography of access within and between settlements and the changes in the spatial distribution of services. This review seeks to provide better access to services in dryland areas, and provide a cross service synthesis of the existing literature and offer new theories.

2. Literature Review Design and Evidence-Selection Protocol

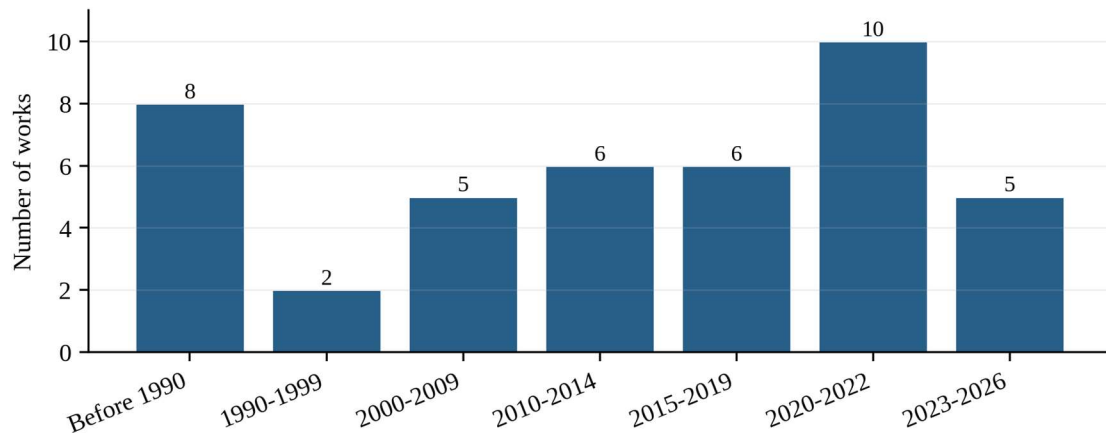
Due to the dispersed nature of the relevant literature across several disciplines, including geography, planning, regional science, public health, education, transport, digital studies, and rural development, a structured critical literature review was adopted. The provided outline included a well-curated planning corpus including 42 foundational and recent documents. This core was further supplemented by targeted searches of recent studies pertaining to West Bengal and authoritative documents. The architecture of the searches included place terms for West Bengal, Bankura, Purulia, Jhargram, Rarh, and the western plateau, and combined with terms of continuum, service, and method. Sources were included if they contained discussions regarding spatial access, service distribution, settlement hierarchy, rural-urban linkages, and regional inequality. Studies pertaining only to migration and descriptive facility inventories were excluded if they failed to analyze distance, time, capacity, and inequality. Foundational concepts were retained if they provided a clearer understanding of the concepts of continuity, access, justice, and the concentration of services.

Evidence was categorized by geography, settlement size, service type, concept of access, source of data, method, and inequality. The focus of the quality of the evidence was on clarity of the concept and the adjustment of the unit of analysis to the reality of the situation and the quality of the evidence. This distinction is critical, as a GIS model may be technically sophisticated, but be substantively weak if the data

for the model is poor. Road speeds, demand locations, and services may be substantially weak when they do not reflect local conditions (Geurs & van Wee, 2004; Páez et al., 2012).

There were three phases of comparison. The first was intra-sector. The second was inter-methods and inter-theories. The third was inter-comparative scales of global, Indian, and West Bengal levels. The resulting methodology is more critical than descriptive. The author regards agreement and contradiction, as well as the effects of different scales and modeling assumptions as findings. The author also cautions that the charts represent the assembled planning corpus and that the charts should not be considered a complete bibliometric survey.

Figure 1: *Temporal Distribution of the Curated Planning Corpus*



Source: Computed by Author

3. Dryland West Bengal and the Rural-Urban Service Continuum

The western plateau and fringe of West Bengal progressively merge with the plains of the lower part of the Chota Nagpur Plateau. There are many natural and man-made challenges to travel here. Public investment and planning of transport networks help to manage the challenges. There can be several challenges to travel, including the need to walk, the disruption of monsoons, poor quality and unpassable roads, and limited night transport. The interpretation of dryland travel networks and the friction that results from seasonal and other changes in the environment must not be determinist.

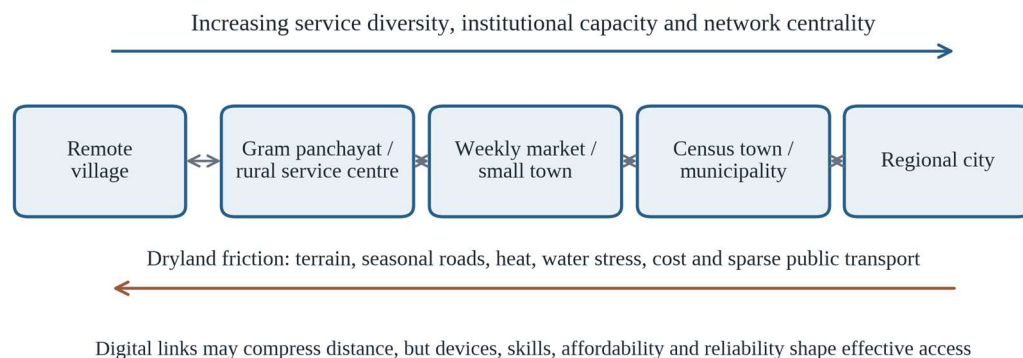
Changes in settlement patterns and increased rural and urban migration have resulted in the formation of new complex urban and rural administrative settlements and hierarchical systems. There are daily and weekly travel circuits as part of the journeys to schools, health care and other administrative and

economic services. The West Bengal studies have shown a relationship between the level of urbanization and settlement size and the availability of basic services, although not all services have improved (Chattopadhyay, 2024; Das et al., 2021; Mondal & Das, 2022). The question that has to be asked is whether services are extended to the rural hinterlands and beyond by the urban and semi-urban administrative centers or whether they merely change the location of the service exclusion points.

A service-node interpretation categorizes settlements based on how population concentration, continuous built land, central roads, frequent public transport, diverse services, different institutions and digital capacity come together. Administrative classifications are helpful but should be regarded as contextual variables rather than a full account of a functional position. For example, with this perspective, you can differentiate a census town with poor public transport and low-order services from a census town with a similar population size, which is a block center with a better regional service.

Figure 1

Conceptual Rural-Urban Service Continuum for Dryland West Bengal



Source: (Geurs & van Wee, 2004; Pahl, 1966; Tacoli, 1998; UN-Habitat, 2019).

4. Integrated Theoretical Framework and Foundational Perspectives

Rural-urban continuum theory argues against the idea that urban and rural areas are distinct categories. According to Pahl (1966), changes in settlements are better analyzed with overlapping social and spatial processes rather than just one of the linear scales. His concept of “a whole series of meshes of different textures” is applicable to dryland West Bengal, where a settlement, may be rural in morphology, urban in service provision, and weak in institutional status at the same time. Current approaches to urban-rural linkages focus on the same aspects: movements, interdependence, and territorial systems (Tacoli,



1998; UN-Habitat, 2019). The strength of the perspective of mixed and intermediary settlements is that there is a continuous gradient. Its weakness is that a continuous gradient may mask abrupt administrative boundaries, social exclusion, tribal marginalization, and uneven political power. For the analysis of services, it is better to have separate physical, functional, institutional, and digital continuums, rather than a composite rurality score.

Accessibility theory understands access as a relationship among people, opportunities, and the systems that connect them. Geurs and van Wee (2004, p. 128) explain that accessibility is "the extent to which land-use and transport systems enable individuals to reach activities or destinations." The importance of this definition is in the connection it makes between the placement of services, the state of the transport system, and the user's capabilities. The measures were differentiated as infrastructure-based, location-based, person-based, and utility-based (Geurs & van Wee, 2004). While proximity measures are simple and easy to interpret, they do not account for supply competition, quality of services, or time-related constraints. Methods based on cumulative opportunities, gravity, and floating catchment provide more comprehensive measures but the results are highly dependent on the thresholds and decay functions and assumptions related to travel (Luo & Qi, 2009; Luo & Wang, 2003). The theoretical differentiation between potential access, realized utilization, and achieved outcomes is of particular significance in rural areas, where a facility that is physically close may still be inaccessible due to cost, staffing, timing, or unreliability of transport.

Spatial justice changes the focus from measurement to evaluation. Referring to Soja's argument where he states, "justice has a geography" (Soja, 2010), makes service distribution a matter of right, recognition and territorial justice/distribution, rather than distance. Unequal distance is not always unjust, and equal distance does not entail justice when service differs in staffing, quality or affordability. A spatial justice perspective looks at distributive justice, procedural justice and recognition. In the context of distribution, we ask who receives the benefits or the capacity and who bears the burden of travel; in the context of procedure, we ask whose priorities determine the travel distance and burden; in the context of recognition, we ask whether planning addresses the barriers to women, the elderly, persons with disabilities, low-income persons and socially excluded groups. Accessibility mapping becomes a justice claim only when certain criteria and the needs of the population are articulated (Neutens, 2015).

Service capacity and the distribution of service nodes are explained by regional development theory. Myrdal's work is most relevant as he noted, "expansion in one locality has backwash effects in other localities" (Myrdal, 1957, p. 39). From the perspective of growth poles and the theory of self-reinforcing development, it is most likely that investment, skilled labor, and high-order institutions will concentrate in

the same location, while peripheral places will experience a decline in service and increased dependency. In contrast to other theories, place-based development emphasizes the specific capabilities, settlement patterns, and the institutional context of different regions (Rodríguez-Pose, 2018). In dryland West Bengal, the core issue is not whether town growth occurs, but whether growth generates spread effects that alleviate the travel burden, reduce costs, and improve the quality of services in neighboring towns.

Together, these perspectives ensure that the review does not simplify accessibility issues to a single factor. Pahl discusses the presence of multiple settlement gradients. Geurs and van Wee analyze the opportunities, networks, and people relations. Soja poses the question regarding the fairness of restricted mobility and access to services. Myrdal assesses the implications of cumulative advantage and concentrated development at the regional level. This framework therefore evolves from classification to measurement, from measurement to justice, and from justice to context-sensitive regional analysis.

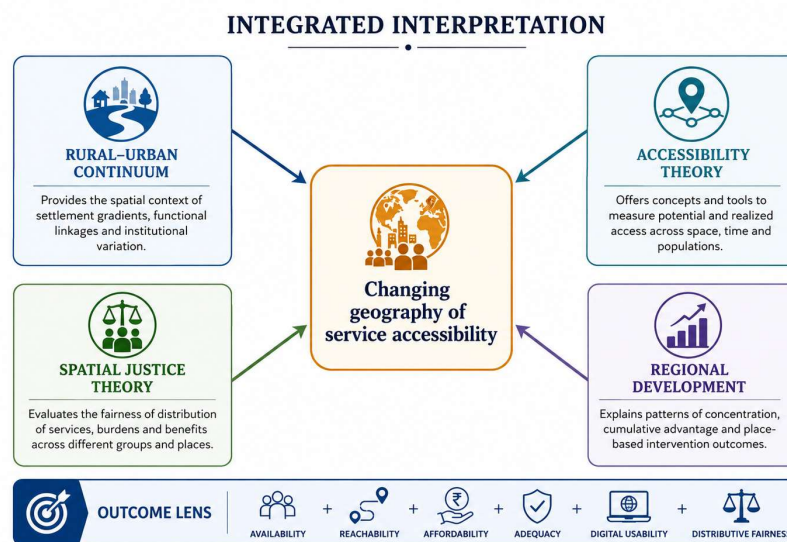
Table 1: *Comparative Theoretical Perspectives*

Theory	Core proposition	Use in this review	Guiding question
Rural-urban continuum	Places occupy multiple morphological, functional and institutional gradients.	Classifies villages, service centres, census towns and municipalities by functional position.	Which continuum dimension best predicts each service?
Spatial justice	Allocation and usability should be evaluated in relation to need, power and recognition.	Distinguishes nominal equality from equitable and usable access.	Who bears travel, cost and quality burdens?
Accessibility theory	Access links opportunities, networks, time and personal capability.	Supplies indicators of reachability, competition and impedance.	Which metric represents effective access in dryland settings?

Theory	Core proposition	Use in this review	Guiding question
Regional development	Investment and services concentrate and diffuse unevenly across a regional system.	Explains service-node hierarchy, cumulative advantage and place-based intervention.	Do intermediate towns spread services or reproduce polarization?

Source: Author's synthesis of Geurs and van Wee (2004), Myrdal (1957), Pahl (1966), Rodríguez-Pose (2018), and Soja (2010).

Figure 2: Integrated Theoretical Framework



Source: (Geurs & van Wee, 2004; Myrdal, 1957; Pahl, 1966; Rodríguez-Pose, 2018; Soja, 2010).

The integrated framework presents five propositions. Typically, accessibility increases with higher settlement centrality, however, this has a unique relationship that is dependent on the services provided. This framework acknowledges that when dealing with routine services intermediate service nodes reduce the burden, however, specialized services continue to be concentrated in regional towns. This framework also states that physical closeness is not enough if there are constraints on the services, be those constraints on capacity, cost or reliability. In some cases, digital connectivity may provide the service to effectively reduce the need to physically travel, augment existing physical transport services, or create a new, exclusionary layer to the transport services available. Finally, the effects of dryland friction are magnified



with weak infrastructure, however, public investment, transport systems, and institutional service coordination reduce the impacts of dryland friction.

5. Thematic Evidence on Service Accessibility

5.1 Healthcare Accessibility

Healthcare research has evolved in understanding the travel time; service area; and the movement and floating catchment models. This evolution has been necessary as the time and distance that are 'reasonable' to travel for the different types of Primary, Emergency and Specialist healthcare vary. Luo and Wang (2003) explained that to understand how to provide healthcare, the supply, demand and distance must be examined together. This was advanced in combination with floating catchment models to explain rural services and how distance decay may be considered (Luo & Qi, 2009).

Indian studies validate that the estimated coverage can vary greatly, depending on the mode and the level of service. Verma and Dash (2020) found that service level approaches combining walk, public transport and private transport produced different accessibility models, with delivery and inpatient services remaining less accessible than most outpatient services. GIS-based research in Bankura (Kanga et al., 2021) suggested new service locations based on the clustering of existing services in central and northern Bankura. This research focused on the Bankura region, and, while it highlighted important implications for service planning, it was limited in that proposed locations of services and optimal routes did not account staff, operational hours, transport service frequency, or affordable transport for households. The most pressing need is for a multimodal, seasonal and capacity-based analysis of transport at the village or habitation level.

5.2 Educational Institutions

Educational accessibility in India varies greatly depending on the level of schooling. While primary schools may be found sparsely across rural India, secondary schools, colleges, technical institutes and vocational centres may be found densely across urban India. Administrative distance may help address some of the issues, but most of the factors that prevent access and use public transport, e.g. traffic, extreme heat, road safety, and even social customs, are not considered. Some Indian network-based studies seek to identify underserved areas to help place schools and optimize geographic site selection using GIS. However, measures of accessibility remain insufficient with use of school proximity, availability of teachers, number of subjects offered and school reputation (Meena et al., 2023).



With the 2023-24 UDISE+, more data of increasing granularity at the level of the school has been provided, however, analyses of this data are still lacking geocoding, age-specific demand, the routes and the methodology (Department of School Education and Literacy, 2024). In the dryland West Bengal region, some schooling is likely to be more easily accessible, while onward schooling to higher levels would depend on the availability of transport to block and municipal center. Quality, mobility and digital learning are rarely included in a single study.

5.3 Market Accessibility

Markets and their resources can be accessed to varying degrees depending on travel time, frequency of the markets, transport cost, and resources like storage, information, and finance. The availability of weekly haats (which are rural markets) helps. Transport links are often stronger for regulated/wholesale markets and are often further away. Research on rural roads in India demonstrates that market pathways and employment opportunities can change due to better rural connectivity. These changes are selective and should not be viewed as equitable access in the markets (Aggarwal, 2018; Asher & Novosad, 2020).

Whether small towns and market settlements are opportunity nodes or new points of dependence become apparent when analyzed through a continuum. Better roads do not eliminate information and storage inequities, and road intermediaries. In western West Bengal, evidence is lacking for seasonal market catchment areas or commodity-based market journeys and the accessibility of market-based finance. A practical approach would also take into account the transport conditions between haats, the availability of return transport, the possibility of trip chaining, and road conditions, rather than the distance to the nearest market.

5.4 Transport Connectivity

Transport is both a means of travel and the system that enables travel to other systems and services. When considering the practicality of travel, factors such as the frequency of buses, waiting times, fares, transfers, the reliability of travel time, and the need for travel in the time of day, are more important than the density and all-weather quality of the roads. Evidence establishes that rural roads influence local development, but the effects of rural roads on access to services must be evaluated directly, and cannot be inferred from changes in income and employment (Aggarwal, 2018; Asher & Novosad, 2020).

Access to services in dryland areas requires seasonal and multi-modal transport modeling. A road may facilitate travel during the day, but may fail to accommodate travel for evening classes, emergency travel, or travel during the monsoon season. Informal shared transport services may fill gaps in the transport



network, but are often excluded from spatial datasets. As a result, maps that display road transport may overstate access to services. A service-center approach will only be effective if public transport and last-mile transport links are provided to connect the rural villages to the bundled services in the intermediate villages.

5.5 Digital Connectivity

Just because something is digitally covered does not mean it is appreciable access. Many aspects can make digital access disallow telemedicine or e-governance. These include, but are not limited to, the affordability, control, and reliability of the digital access of a given household as well as the skills, trust, and language of the household. When addressing the rural digital divide, many of the reviewed articles consider availability, adoption, and the effective use of digital access as separate and distinct inequalities (Salemink et al., 2017; Lythreitis et al., 2022). The multiple researches focused on the rural women of West Bengal consider the presence of the network as opposed to the skills and literacy, as well (Banerjee et al., 2024).

ICT diffusion within West Bengal is spatially uneven and shows the necessity of focusing on an intra-state level (Satpati & Sharma, 2026). National subscriber data is still indicative of a rural-urban divide in India within the tele-density and Internet coverage, despite gradual improvement (Telecom Regulatory Authority of India, 2026). Digital services, while helpful, still leave many services a distance away. Many institutional processes are still hybrid and require cash, documents, and/or assistance.

5.6 Banking and Financial Services

Financial accessibility includes branches, ATMs, business correspondents, cooperatives, post-office banking and digital channels. Simply owning an account does not denote adequate inclusion. Inclusion extends to the account user, the availability of cash and credit, the occurrence of transactions, documentation and consumer protection. According to the Reserve Bank of India, while the national financial-inclusion index shows access improvement, usage and quality of inclusion in India have also improved. However, while national improvement is observed, it does not imply all regions quality of services has improved (Reserve Bank of India, 2024).

In the dry land districts of India, the interdependence of physical and digital financial networks is evident. For example, a business correspondent may be physically close, but may be cashless and/or offline, making the correspondent unusable. Meanwhile, the digital network may require a payment device, trust, and assistance. Branches and ATMs tend to be concentrated in the larger administrative units (block) and small towns, often resulting in a continuous dependence of rural areas on the few urban centers. Research

should move beyond the simplistic method of measuring the distance to the nearest service outlet, and should incorporate the range, reliability, and the quality of financial services offered.

5.7 Rural Development Infrastructure and Cross-Service Interdependence

Electricity, potable water, sanitation, storage, service centers, and community facilities create a cumulative infrastructure system. One must consider whether infrastructure is present, operational and dependable. Studies conducted in West Bengal show that access to basic services is influenced by civil amenities, size of settlement, location and regional proximity. Recent geospatial studies have shown considerable variation in the access to services for water, sanitation and hygiene, with the western districts of the country being the most disadvantaged. Evidence on social development from Paschim Medinipur shows that a composite progress of services is also uneven (Kar & Bhunia, 2023).

The most compelling reason to conduct a comprehensive review is the interdependence of services. Access to hospitals, schools and banks is reliant on transport. Access to services is reliant on electricity and water, and access to services is reliant on digital infrastructure. An intermediate town enables a household to combine multiple trips for different purposes. The cumulative effects of disadvantages can be felt. A composite index may show cumulative exclusion, but domain scores must be reported, as a strong score in digital infrastructure cannot eliminate the effects of inadequate emergency healthcare and safe drinking water.

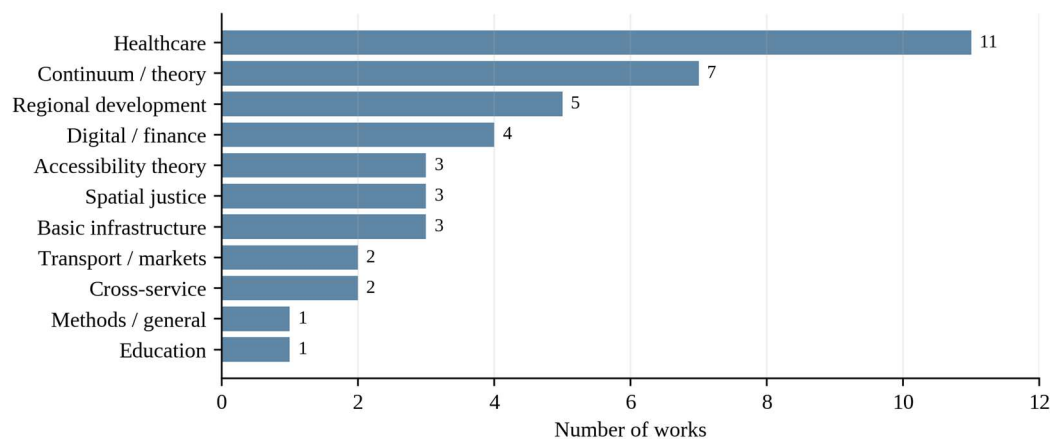
Table 2: *Service Accessibility Dimensions and Central Tensions*

Domain	Core spatial indicators	Non-spatial modifiers	Central tension
Healthcare	Travel/referral time; capacity-sensitive catchments	Staffing, beds, hours, cost	Distance versus adequate care
Education	Network time by institutional level	Teachers, subjects, safety, digital learning	Basic proximity versus progression
Markets/transport	Travel time, frequency, generalized cost, centrality	Seasonality, fares, reliability, storage	Connectivity versus practical mobility

Domain	Core spatial indicators	Non-spatial modifiers	Central tension
Digital/finance	Coverage, speed, outlets, transaction reliability	Devices, skills, cash, trust, affordability	Nominal inclusion versus usable access
Rural infrastructure	Functional domain scores and deprivation clusters	Maintenance, quality, resilience	Presence versus cumulative functionality

Source: Thematic literature reviewed in Section 5, particularly Aggarwal (2018), Asher and Novosad (2020), Kar and Bhunia (2023), Luo and Qi (2009), Luo and Wang (2003), Lythreatis et al. (2022), Meena et al. (2023), Reserve Bank of India (2024), and Salemink et al. (2017).

Figure 3: *Primary Thematic Emphasis in the Curated Planning Corpus*



Source: Computed by Author

6. Methodological Approaches and Measurement Controversies

GIS network analysis computes shortest-distance or shortest-time pathways through routable roads and can additionally compute service areas, centrality measures, and location scenarios. The analysis's realism is largely dependent on a variety of factors including topology, disconnected settlements, bridges, road hierarchy, assumed speeds, and transportation modes. Raster cost-distance can be a valuable alternative in scenarios where off-road movement and terrain are relevant, however, both approaches can easily misrepresent mobility in rural settings if assumed to be car dependent. The most appropriate framework for



dryland West Bengal is a multi-modal network of walking, cycling, buses, and shared vehicles, along with other possible temporary road improvements.

Travel time is usually more understandable than travel distance. However, various travel times must be disambiguated. For example, travel time on a road in free-flow traffic is different than travel time on scheduled public transport, than travel time in a door-to-door multimodal scenario, than generalized travel cost. While waiting, travel time, cost, and other factors can significantly impact the experience for rural users. Therefore, multiple travel time thresholds should be defined. Travel time for the nearest facility should be defined for a higher order facility that is functioning, adequately staffed, and is a higher order facility (Verma & Dash, 2020).

Accessibility mapping includes buffers and cumulative opportunity measures, and extends all the way to gravity and floating catchment models. The two-step floating catchment model incorporates supply, demand and distance, however, the results can largely vary based on catchment size, decay weights and competition assumptions (Luo & Qi, 2009). More realism can be achieved with person based models, however, detailed data is required. In all cases, administrative averages should not be assumed to be representative of all areas.

Methods such as global and local Moran's I, local indicators of spatial association, and Getis-Ord statistics, find concentrations of advantage, disadvantage, and spatial outliers. These methods have their nuances, such as with spatial weights, scale, edge effects, and multiple testing. Hotspots are patterns that need an explanation, and are generally not indicative of a causal mechanism. To identify hidden small pockets of exclusion, the village, gram-panchayat, and block levels need to be reviewed because of the Modifiable Areal Unit Problem (MAUP).

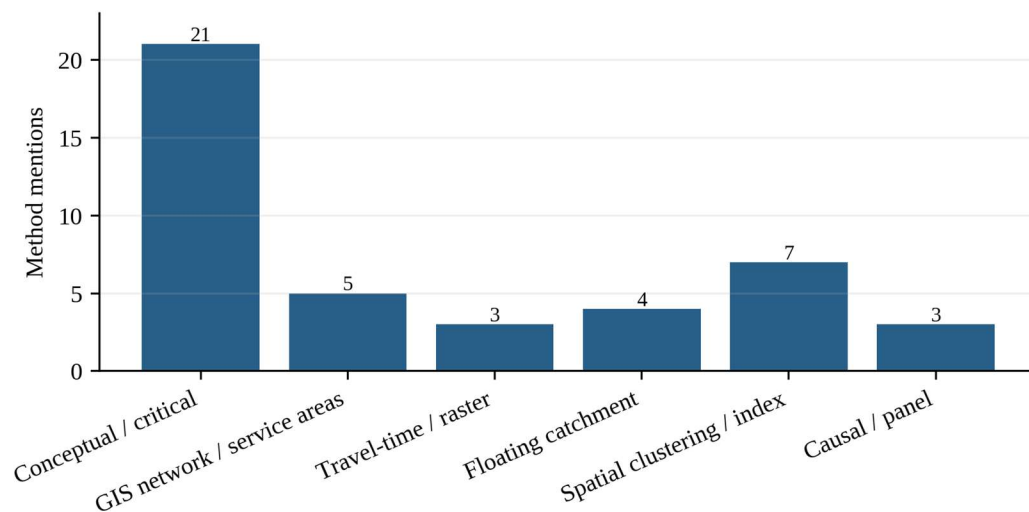
Cumulative advantage can be put together using a Composite Service Accessibility Index, but together a rank position might destabilize or a compensation effect might be induced. It is mandatory to be clear how direction, missing data, normalization, aggregation, and weights are set. Equal weights, weights derived from expert judgment, principal-components weights, and policy-priority weights should be applied. Domain scores should be published along with the total index, and a non-compensatory framework should be adopted so extreme healthcare deprivation cannot be compensated.

Table 3: *Comparative Appraisal of Major Methodological Approaches*

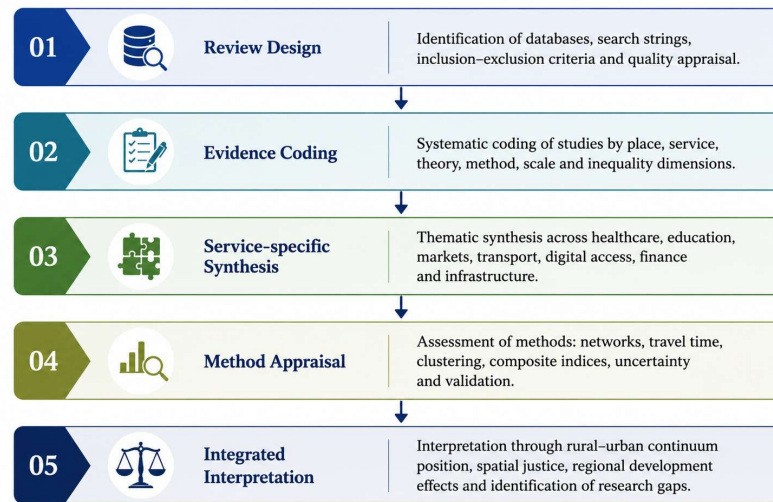
Method	Typical output	Strength	Main limitation	Best-practice adaptation
GIS network analysis	Shortest paths and service areas	Represents actual routes	Topology and speed assumptions	Use multimodal and seasonal networks
Travel-time analysis	Minutes to nearest/adequate service	Policy-readable impedance	Waiting and threshold sensitivity	Model door-to-door time and generalized cost
Floating catchment / gravity	Capacity- and competition-sensitive access	Links supply, demand and distance	Catchment and decay choices	Test alternative thresholds and quality weights
Spatial clustering	Hotspots, cold spots and outliers	Reveals concentration and local exceptions	MAUP and non-causal interpretation	Compare scales and spatial weights
Composite index	Domain and overall scores	Communicates cumulative deprivation	Compensation and rank instability	Publish domains, uncertainty and sensitivity

Source: Geurs and van Wee (2004), Luo and Qi (2009), Luo and Wang (2003), Neutens (2015), and Verma and Dash (2020).

Figure 5: Methodological Approaches Represented in the Curated Corpus



Source: Computed by Author

Figure 6: Review and Synthesis Workflow

Source: Computed by Author

Common weaknesses recur across the literature: The use of Euclidean distance in relation to terrain and roads, administrative centroids that conceal inequalities within administrative units, counting facilities without considering their capacity and reliability, single-mode free-flow travel, population, roads, and facilities that are out of sync temporally, restricted seasonality, and composite indices that are without sensitivity testing, represent just some of the major weaknesses in current accessibility modeling efforts. The most important of these major weaknesses is the lack of validation. Accessibility modeling should be compared against GPS traces, journey diaries, reported travel times, usage, or service outcomes before it can be considered an accurate representation of lived accessibility.

7. Comparative Synthesis: Global, Indian and West Bengal Evidence

Foundational work in global literature shows how access is shaped by settlement size, transport mode and service capacity, alongside longer travel times that are characteristic of much of the non-metropolitan world (Almeida et al., 2024; OECD, 2024). Floating catchment-based and travel-time models can provide some guidance, but the assumptions regarding rural transport and capital-intensive services articulated for car travel in India are not easily transferable. The main lesson learned is that a plurality of methodologies is essential; to fully address reachability, competition, quality, affordability and equity requires multiple measures.

Indian studies in rural roads, public health, education, and the urbanization of census towns provide more relevant evidence. Indian National studies provide a more detailed overview of rural conditions, but do not adequately address the informal transport and service volatility that define rural areas. The impact of roads also demonstrates the need to separate the outcome of an economic impact study from the accessibility study.

Emerging evidence from West Bengal is also fragmented. Studies of comparative census towns/township; mapping basic amenities; studies of peri-urban inequality; health care location studies in Bankura; and studies of social development in Paschim Medinipur; WASH and ICT studies (Chattopadhyay, 2024; Kanga et al., 2021; Kar & Bhunia, 2023; Satpati & Sharma, 2026; Trivedy & Khatun, 2024) are sectorial and study the Census 2011 and other snapshot data. None of these studies incorporate a consideration of travel between villages, public transport, service gaps, or households' digital capabilities.

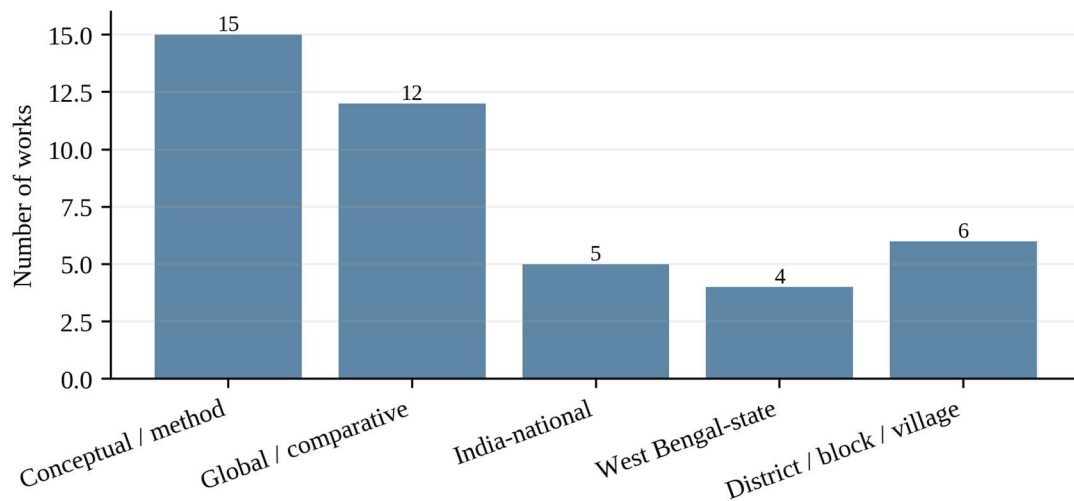
Table 4: *Selected Comparative Studies and Relevance*

Study	Context	Approach	Contribution and caution
Tacoli (1998)	Global rural-urban linkages	Critical review	Flows connect rural production, markets and services; limited digital dimension.
Geurs & van Wee (2004)	Transport/accessibility	Method review	Metrics differ in theory and policy meaning; useful for measure selection.
Verma & Dash (2020)	Rural/remote India	Raster/vector travel time	Modes and service packages produce different coverage; requires local validation.
Kanga et al. (2021)	Bankura	GIS suitability/network analysis	Direct district evidence on spatial mismatch; capacity and seasonality need extension.
Chattopadhyay (2024)	West Bengal settlements	Spatial/regression analysis	Service access differs among villages, census towns and statutory towns.

Study	Context	Approach	Contribution and caution
Satpati & Sharma (2026)	West Bengal blocks	PCA and spatial analysis	ICT diffusion is uneven; physical-digital integration remains open.

Source: Tacoli (1998), Geurs and van Wee (2004), Verma and Dash (2020), Kanga et al. (2021), Chattopadhyay (2024), and Satpati and Sharma (2026).

Figure 7: Geographic Scale of Evidence in the Curated Planning Corpus



Source: Computed by Author

8. Major Research Gaps and Future Agenda

The initial conceptual gap results from rural and urban administrative units typically being arrayed, while functional gradients and intermediate service units remain unspecified. There also remain regional, cross-sectoral and interstitial gaps. Rural dryland West Bengal, for example, is seldom addressed as an integrated service area where mobility and institutional and infrastructural networks (settlement, hierarchy and concentration) interact. How healthcare, education, transport, digital inclusion and financial services are analyzed is another cross-sectoral gap.

Several measurement gaps are evident. Car-based or ideal-speed models ignore walking, buses and other shared transport, trip waiting, payment, transport and activity chains. Too often, presence of a facility is assumed to mean staffing, beds or subjects, transaction and operational success. Seasonal variability, opening times and night journeys are often ignored. Closed institutions, physical and digital access are



seldom addressed within a single framework, even though digital services are interdependent with F and Mn, connectivity and support.

The social and temporal gaps also exist. Gender, disability, poverty and social exclusion are rarely incorporated into spatial models. Reliance on Census 2011 and disjointed facility and population years constrain analysis of recent change. District or block averages hide village-level variation. Model-based accessibility is rarely validated by actual journeys and utilization. Finally, empirical composite indices are devoid of theoretical weights, and rank-stability tests and uncertainty estimates are ignored.

These gaps lead to a focused research agenda: Along one settlement continuum, compare domain-specific gradients. Determine which intermediate nodes (settlements) lessen the travel burden the most. Examine the influence of season variation, travel modes, and thresholds. Provide an explanation for the observed high modeled access yet low realized use. Assess where mobile and digital services would be a value-adding service (i.e. a service that improves the customer experience vs. a service that is a low-quality substitute) for permanent services. The main concern is how to use place-based planning to achieve an optimal balance between population efficiency and spatial justice in sparsely populated and remote settlements.

9. Proposed Analytical Framework for Subsequent Empirical Research

Village or habitation settlement areas should be the units of demand that connect to the gram panchayat, block, census town, and municipality. Population density and built-up form, along with road centrality, varied facilities, public transport, and digital connectivities, can be indicators along a multidimensional continuum. Administrative units should remain in this continuum, but they should not be the sole determinants.

Each continuum should represent a measure of service. Healthcare should represent some form of floating catchment where multi-modal travel time and level of healthcare facilities are supported by staff and service capacity. Education should represent travel time to reach age-specific and differentiated levels of service, including primary, secondary, higher-secondary schools, colleges, and vocational services. Market services should represent service frequency and the hierarchy of goods. Transport services should represent an all-weather transport system that is reliable and cost-effective with defined waiting time. Digital services should represent access that is affordable, prompt, and reliable with varying speeds along access points and public terminals. Financial services should represent an infrastructure that is reliable and



allows digital transactions and varies in the presence of branches, ATMs, and correspondent services. Infrastructure should be assessed on a reliable and functional basis.

Separate domain scores should be computed before an overall index. Weights, either equal or calibrated, should be compared along with indicators in a common direction. Aggregation should be compensatory and non-compensatory. Spatial justice should measure accessibility in relation to need, poverty, age structure, social group composition, and remoteness to identify clusters with high need and low access. To understand the patterns, evidence should be mapped to illustrate perceived barriers and institutional reliability.

Validation should comprise checks on roads and facilities, validation of operations and hours, as well as comparison of modeled travel times to GPS or reported household data. Sensitivity testing should include modifications of speeds, seasons, thresholds, and weights (spatial and index). Policy scenarios can test enhanced rural service centers, better scheduled transport, mobile services, and mixed digital-physical service points. The co-location of compatible services can help alleviate cumulative travel burdens by supporting journeys of multiple purposes.

10. Conclusion

The literature suggests that the organization of services in the dryland West Bengal region would likely be following a nested hierarchy of the regional towns, small urban nodes, and rural service centers. For many services, accessibility improves with centrality, but that remains neither continuous nor guaranteed. Routine services may be found in intermediate settlements, but specialized services such as healthcare, education, markets, and complex financial services are still concentrated. Network friction, service capacity and cost, and household capability determine whether nominal opportunities translate into access.

The literature becomes more coherent when the four theoretical perspectives are read together. Rural-urban continuum theory identifies the multiple functional positions occupied by settlements and accessibility theory assesses the relations among opportunities, networks, time, and personal capability. The distribution and usability of those opportunities are assessed by the spatial justice theory, whereas regional development theory explains the reasons for the concentration, dispersion, or retention of polarization. Pahl, Geurs and van Wee, Soja and Myrdal all provide foundational observations that show the central issue is not distance, but the territorial organization of sufficient, reliable, affordable and socially acceptable services.



The primary methodological insight is that, without validated models incorporating multiple modes, time and capacity, realistic accessibility cannot be achieved. Rural users are often hidden behind static count models, Euclidean buffers, and speed models. Domain scores, along with uncertainty/sensitivity analyses, should be appended to composite measures. The main evidence gap is the drylands of the west of the state and a cross-service, village-level and seasonally responsive analysis. This type of analysis will enable place-based planning to enhance intermediate service nodes and improve scheduled and last-mile transport. It will also allow the use of digital systems as complements to equitable physical provision.

References

- Aggarwal, S. (2018). Do rural roads create pathways out of poverty? Evidence from India. *Journal of Development Economics*, 133, 375–395. <https://doi.org/10.1016/j.jdeveco.2018.01.004>
- Almeida, V., Hoffmann, C., Königs, S., Moreno-Monroy, A. I., Salazar-Lozada, M., & Terrero-Dávila, J. (2024). *Geographic inequalities in accessibility of essential services* (OECD Social, Employment and Migration Working Papers No. 307). OECD Publishing. <https://doi.org/10.1787/12bab9fb-en>
- Asher, S., & Novosad, P. (2020). Rural roads and local economic development. *American Economic Review*, 110(3), 797–823. <https://doi.org/10.1257/aer.20180268>
- Banerjee, R., Trappel, J., & Van Audenhove, L. (2024). Evaluating meaningful connectivity: Digital literacy and women in West Bengal, India. In S. Yates & E. Carmi (Eds.), *Digital inclusion: International policy and research* (pp. 225–248). Palgrave Macmillan. https://doi.org/10.1007/978-3-031-28930-9_11
- Chattopadhyay, S. (2024). Spatial analysis of access to basic services in urban West Bengal: Disparities and determinants. *Journal of Asian and African Studies*, 59(5), 1516–1538. <https://doi.org/10.1177/00219096221141343>
- Das, A., Das, M., & Barman, H. (2021). Access to basic amenities and services to urban households in West Bengal: Does its location and size of settlements matter? *GeoJournal*, 86, 885–913. <https://doi.org/10.1007/s10708-019-10101-6>
- Department of School Education and Literacy. (2024). *UDISE+ 2023–24 report*. Ministry of Education, Government of India. https://dashboard.udiseplus.gov.in/report2026/static/media/UDISE%2B2023_24_Booklet_existing.309eabf9e4889db93bcb.pdf



- Geurs, K. T., & van Wee, B. (2004). Accessibility evaluation of land-use and transport strategies: Review and research directions. *Journal of Transport Geography*, 12(2), 127–140.
<https://doi.org/10.1016/j.jtrangeo.2003.10.005>
- Kanga, S., Kranjčić, N., Singh, S. K., Raja, S., & Đurin, B. (2021). A geospatial approach for site suitability and accessibility for healthcare services in Bankura district, West Bengal, India. *Present Environment and Sustainable Development*, 15(2), 81–91. <https://doi.org/10.15551/pesd2021152007>
- Kar, S., & Bhunia, G. S. (2023). Spatial inequality of social development: A case study in Paschim Medinipur District, West Bengal, India. *Global Social Welfare*, 10, 371–382.
<https://doi.org/10.1007/s40609-023-00302-w>
- Luo, W., & Qi, Y. (2009). An enhanced two-step floating catchment area method for measuring spatial accessibility to primary care physicians. *Health & Place*, 15(4), 1100–1107.
<https://doi.org/10.1016/j.healthplace.2009.06.002>
- Luo, W., & Wang, F. (2003). Measures of spatial accessibility to health care in a GIS environment: Synthesis and a case study in the Chicago region. *Environment and Planning B: Planning and Design*, 30(6), 865–884. <https://doi.org/10.1068/b29120>
- Lythreath, S., Singh, S. K., & El-Kassar, A.-N. (2022). The digital divide: A review and future research agenda. *Technological Forecasting and Social Change*, 175, Article 121359.
<https://doi.org/10.1016/j.techfore.2021.121359>
- Meena, D. K., Tripathi, R., & Agrawal, S. (2023). An evaluation of primary schools and its accessibility using GIS techniques: A case study of Prayagraj district, India. *GeoJournal*, 88, 1921–1951.
<https://doi.org/10.1007/s10708-022-10715-3>
- Mondal, S., & Das, D. N. (2022). Availability of basic amenities to urban households in West Bengal: An analysis of the level and determinants. *GeoJournal*, 87, 2863–2882. <https://doi.org/10.1007/s10708-021-10376-8>
- Myrdal, G. (1957). *Economic theory and under-developed regions*. Duckworth.
- Neutens, T. (2015). Accessibility, equity and health care: Review and research directions for transport geographers. *Journal of Transport Geography*, 43, 14–27.
<https://doi.org/10.1016/j.jtrangeo.2014.12.006>



- OECD. (2024). *Getting to services in towns and villages: Preparing regions for demographic change*. OECD Publishing. <https://doi.org/10.1787/df1e9b88-en>
- Páez, A., Scott, D. M., & Morency, C. (2012). Measuring accessibility: Positive and normative implementations of various accessibility indicators. *Journal of Transport Geography*, 25, 141–153. <https://doi.org/10.1016/j.jtrangeo.2012.03.016>
- Pahl, R. E. (1966). The rural-urban continuum. *Sociologia Ruralis*, 6(3), 299–329. <https://doi.org/10.1111/j.1467-9523.1966.tb00537.x>
- Reserve Bank of India. (2024, July 9). *Financial inclusion index for March 2024* [Press release]. https://www.rbi.org.in/scripts/FS_PressRelease.aspx?prid=58259
- Rodríguez-Pose, A. (2018). The revenge of the places that don't matter (and what to do about it). *Cambridge Journal of Regions, Economy and Society*, 11(1), 189–209. <https://doi.org/10.1093/cjres/rsx024>
- Salemink, K., Strijker, D., & Bosworth, G. (2017). Rural development in the digital age: A systematic literature review on unequal ICT availability, adoption, and use in rural areas. *Journal of Rural Studies*, 54, 360–371. <https://doi.org/10.1016/j.jrurstud.2015.09.001>
- Satpati, S., & Sharma, K. K. (2026). Decoding digital transformation in West Bengal: A block-level spatial analysis of ICT diffusion with tele-density trends. *Quality & Quantity*, 60, 7547–7579. <https://doi.org/10.1007/s11135-026-02588-2>
- Soja, E. W. (2010). *Seeking spatial justice*. University of Minnesota Press.
- Tacoli, C. (1998). Rural-urban interactions: A guide to the literature. *Environment and Urbanization*, 10(1), 147–166. <https://doi.org/10.1177/095624789801000105>
- Telecom Regulatory Authority of India. (2026, March 3). *The Indian telecom services performance indicators: October–December 2025*. https://traa.gov.in/sites/default/files/2026-03/QPIR_03032026_0.pdf
- Trivedy, A., & Khatun, M. (2024). Water, sanitation, and hygiene condition in West Bengal, India: Exploring geospatial inequality, patterns, and determinants. *GeoJournal*, 89, Article 32. <https://doi.org/10.1007/s10708-024-11034-5>



- UN-Habitat. (2019). *Urban-rural linkages: Guiding principles and framework for action to advance integrated territorial development*. <https://unhabitat.org/sites/default/files/2020/03/url-gp-1.pdf>
- Verma, V. R., & Dash, U. (2020). Geographical accessibility and spatial coverage modelling of public health care network in rural and remote India. *PLOS ONE*, 15(10), Article e0239326. <https://doi.org/10.1371/journal.pone.0239326>