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Research Article

Developing a Village-Level Utility Access Index for Micro-Level Planning in Kharkhoda Block, Sonipat District

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ABSTRACT

Balanced rural development depends on fair access to essential utilities, yet disparities at the village scale remain a persistent challenge. To capture these variations, a Village-Level Utility Access Index (VUAI) was designed for Kharkhoda Block in Sonipat District. The index incorporates indicators of drinking water, financial and postal services, mobility infrastructure, community centres, veterinary care, policing and fuel availability. Each service was assessed through population-based norms, normalised adequacy scores and weighted aggregation to create composite village-level values. Results highlight universal adequacy of drinking water but reveal significant gaps in social and civic amenities, particularly parks, community facilities and bus shelters. By translating complex data into an accessible framework, the VUAI supports micro-level planning, enabling targeted and transparent interventions for underserved settlements.

Keywords: Village-Level Utility Access Index, Micro-level Planning, Rural Infrastructure, Civic Amenities, Haryana, Sonipat District, Public Services, Spatial Disparities, Rural Development.

Introduction

Rural development planning aims to provide essential infrastructure fairly across all settlements, ensuring that living in a small village does not automatically mean reduced access to public services. In India, the idea of decentralised planning has long recognised villages as suitable units for micro-level initiatives, since they are closely connected to everyday realities and allow for context-specific solutions (Mishra, 1992; Sen, 1972). A persistent challenge however, lies in measurement: to what extent do villages actually enjoy basic utilities and where are the major gaps? Creating composite indices from clear and policy-relevant indicators offers a reliable way to answer this question, enabling scarce resources to be channelled where the need is most urgent (Adinarayana, Raj & Sharma, 2004; Sarkar, 2018). This study develops a Village-level Utility Access Index (VUAI) for Kharkhoda Block in Sonipat District, Haryana. The index covers civic and public facilities that shape everyday life and mobility, such as banks, post offices, bus shelters, parks, playgrounds, community centres, police services, petrol stations, veterinary care and drinking-water provision. The framework is based on official guidelines from the Government of India (URDPFI 2015; RADPFI 2017; NBC 2005; NRDWP 2013) and adjusted according to village population, ensuring comparisons remain fair across settlements of different sizes (Qaiyum, 2004; Rao, 2012). The analysis relies on a block-wide field survey conducted in 2019, which combined household visits, facility-level GPS mapping and supplementary records (Census of India 2011; Directorate of Census Operations, Haryana 2011). Each service was scored for every village, normalised, weighted and then aggregated into a composite index. Villages were subsequently placed into access categories to guide targeted planning.

Utility Access at the Village Level

"Access" to public utilities combines *availability* (is the service present?) and *adequacy* (is scale commensurate with population?) (URDPFI, 2015; Sarkar, 2018). For rural amenities, national guidance codifies minimum service ratios, e.g., 1 bank per 10,000, 1 park per 5,000, 1 post office per 15,000, 1 police post per 50,000 people and 40 LPCD drinking water in rural areas (URDPFI, 2015; NBC, 2005; NRDWP, 2013). Translating these norms to the village scale requires normalising raw counts by population, capping at adequacy (=1.0) and leaving room to capture the presence of non-normed assets (e.g., petrol pumps, bus queue shelters) that

enhance everyday mobility and economic functioning (Jain, Kushwaha & Agarwal, 2017; Kaushik, Kandpal & Pandey, 2017).

Composite Indices for Local Development

Composite indices reduce multi-dimensional information to a tractable number while preserving policy levers in component indicators (Hotelling, 1933; Ohlan, 2013). Three choices are main: indicator selection (must be policy-relevant and measurable), normalisation (to make indicators dimensionless and comparable) and weighting/aggregation (to reflect relative importance) (Malczewski, 2004; Jaybhaye, Mundhe & Dorik, 2014). For decision-support, simple and transparent transforms-such as min-max scaling to an adequacy cap of 1.0 and fixed weights linked to norms-are often preferable to opaque methods, especially when indices will be audited by communities and line departments (Rao, 2012; Sarkar, 2018).

Study Area

Kharkhoda Block lies in the southern part of Sonipat District, Haryana, bounded by Ganaur and Sonipat Blocks to the north, Rai to the east, Rohtak to the west and the National Capital Territory (NCT) of Delhi to the south-east. Geographically it spans 296.9 km² and comprises 44 villages and one urban local body (Kharkhoda MC) (Census of India, 2011; Directorate of Census Operations, Haryana, 2011). Village-wise projected 2019 populations (derived by exponential growth from 2001 and 2011 Census counts) range from 379 (Kiroli) to 29,870 (Kharkhoda MC), with most villages between 1,200–7,600 (see Table 1.3). Road connectivity is robust via SH-18 and SH-20 with numerous village roads linking the block to Sonipat, Rohtak, Gohana and Bahadurgarh (PWD, Kharkhoda, 2019). The block's socio-economic profile features intensive agriculture, expanding peri-urban activities and a mosaic of settlement sizes that make it a suitable testing ground for village-scale access measurement (HARSAC, 2018; Saroj et al., 2014).

Data and Analytical Framework

Data Sources

(1) **Primary facility audit (2019):** GPS-enabled enumeration of non-health utilities (banks, post offices, bus queue shelters, parks, playgrounds, community centres, petrol pumps, police stations/chowkies, veterinary dispensaries/hospitals) in all 44 villages and Kharkhoda MC.

(2) **Secondary data:** Village-wise population (Census 2001, 2011; 2019 projections via exponential growth), drinking-water availability (LPCD) by village and official service norms (URDPFI, RADPFI, NBC, NRDWP).

(3) **Referential maps:** Maps for banks, post offices, parks, playgrounds, community centres, police, petrol pumps and veterinary services (Figures 1.1–1.9) are referenced.

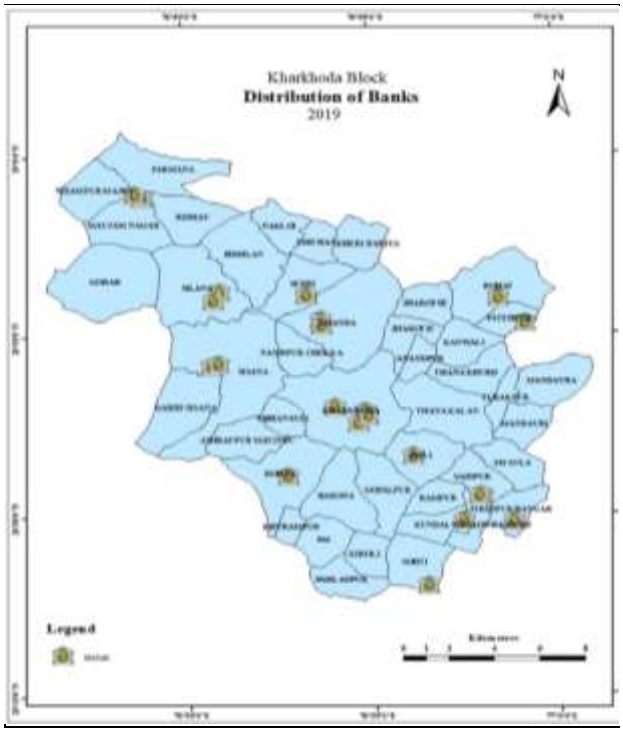
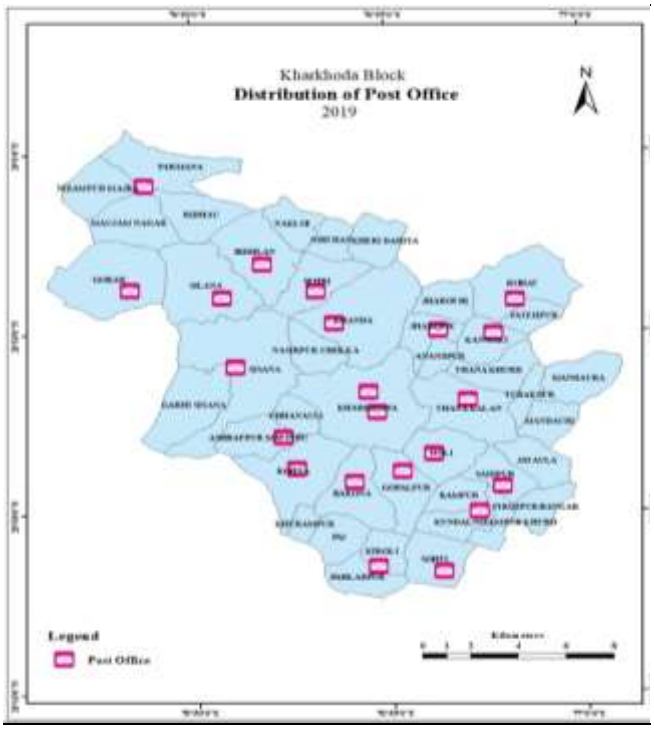


Figure 1.1



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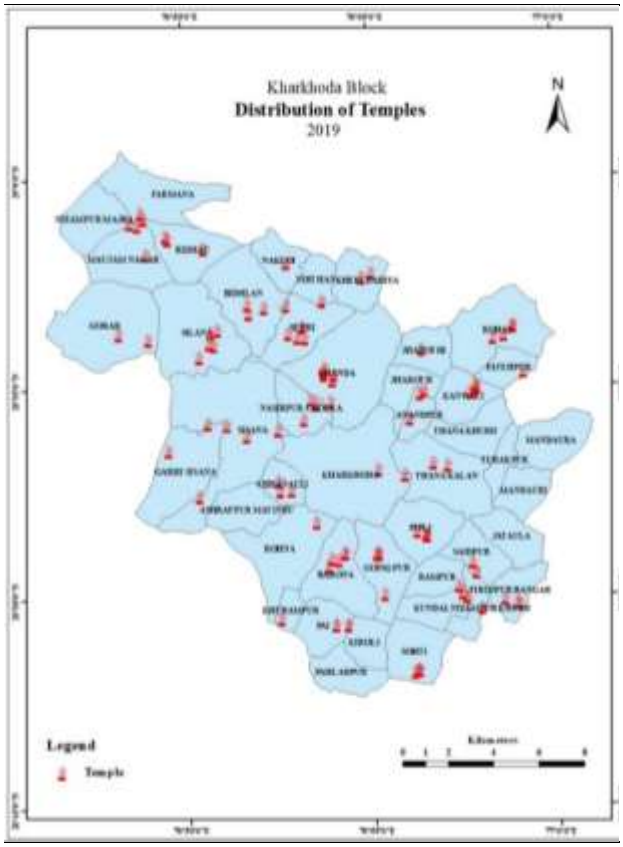

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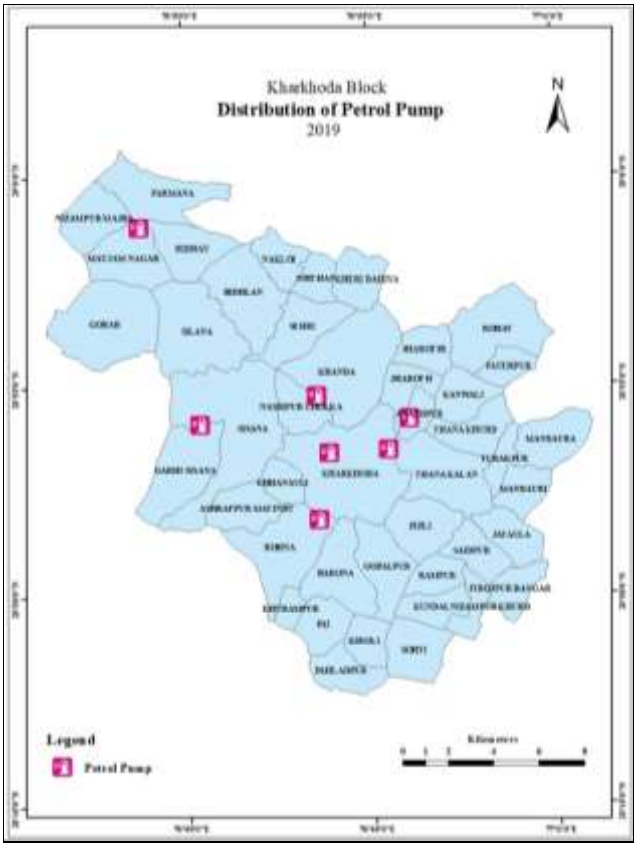

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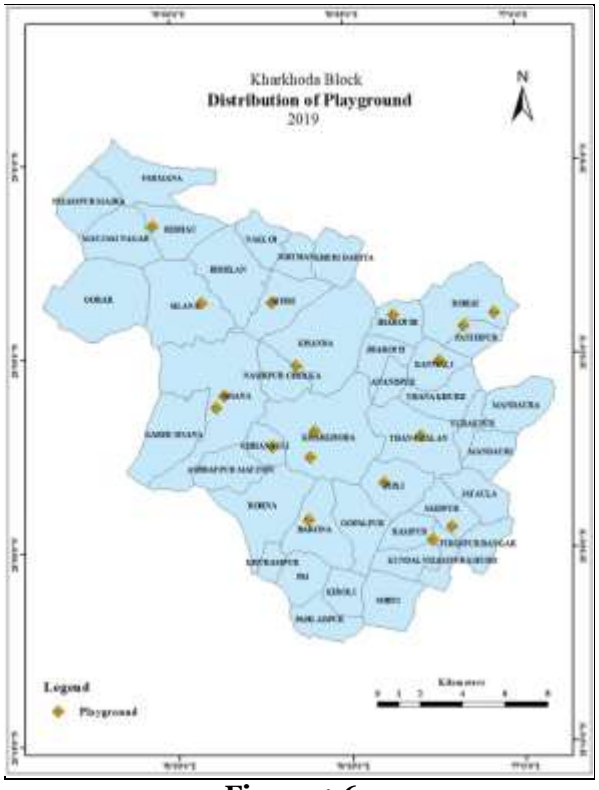

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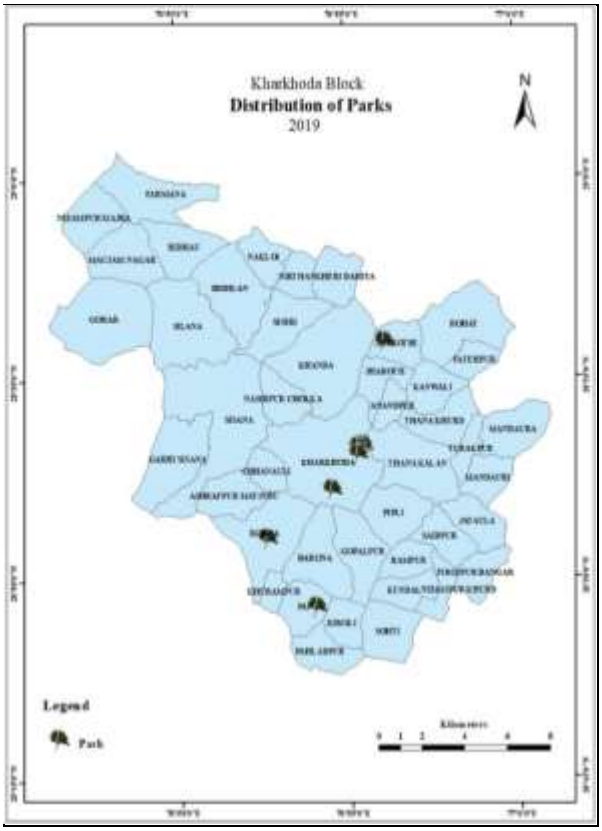

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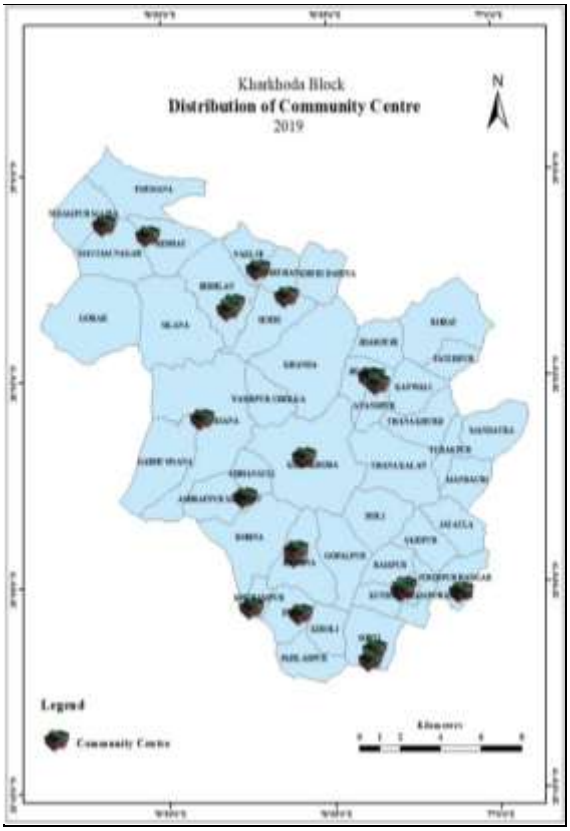

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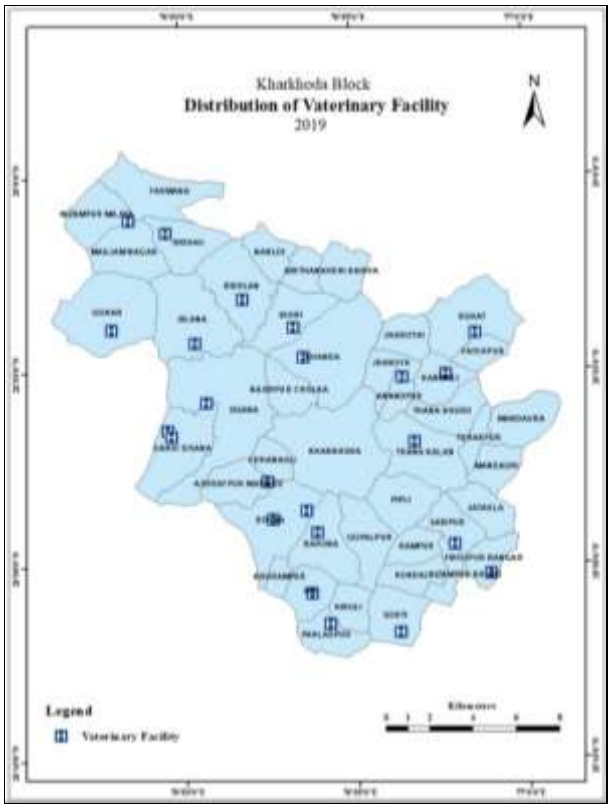

Figure : 1.9

Indicators, Normalisation and Weights

Indicators were selected for (i) policy relevance; (ii) data availability at village scale; and (iii) link to norms. For each village v and service k, we compute a normalised adequacy score $I_{v,k} \in [0,1]$:

(1) For services with population-based norms (banks, post offices, parks, playgrounds, community centres),

$$I_{v,k} = \min\left(1, \frac{S_{v,k} \times N_k}{P_v}\right),$$

where $S_{v,k}$ = count of service k in village v, N_k = people served per service under the norm (e.g., 10,000 for banks; 15,000 for post offices; 5,000 for parks/playgrounds/community centres) and P_v = population of v.

(2) For drinking water, adequacy is normed to 40 LPCD (NRDWP, 2013):

$$I_{v,\text{water}} = \min\left(1, \frac{\text{LPCD}_v}{40}\right).$$

(3) For bus queue shelters (and bus stand in Kharkhoda MC), a binary presence suffices at the village scale due to lack of official per-capita norms; $I_{v,\text{bus}} = 1$ if present, else 0.

(4) For police and petrol pumps, presence is also treated as binary at the village scale: $I_{v,\text{police}}, I_{v,\text{petrol}} \in \{0,1\}$, noting that policing catchments exceed village boundaries; binary presence flags potential proximity and faster response (URDPFI, 2015; NBC, 2005).

(5) For veterinary services, because norms vary by state and facility type, we construct an equivalency unit: hospital = 1.0; dispensary = 0.5. Adequacy is then

$$I_{v,\text{vet}} = \min\left(1, \frac{(\text{Hosp}_v + 0.5 \times \text{Disp}_v) \times 5{,}000}{P_v}\right).$$

Weights. Weights reflect the life-supporting role of water and the everyday centrality of mobility and civic amenities, while maintaining simplicity for administrative use (URDPFI, 2015; MoPR, 2017):

$$\text{VUAI}_v = 0.20 \times I_{v,\text{water}} + 0.10 \times \left(I_{v,\text{bank}} + I_{v,\text{post}} + I_{v,\text{park}} + I_{v,\text{play}} + I_{v,\text{comm}} + I_{v,\text{vet}} + I_{v,\text{bus}}\right) + 0.05 \times \left(I_{v,\text{police}} + I_{v,\text{petrol}}\right).$$

Weights sum to 1.00 and can be tuned in future participatory rounds (Rao, 2012; Biswas & Kumar, 2017).

Computation and Classification

For each village, we compiled service counts, calculated indicator-wise adequacy scores, aggregated to VUAI and classified results into five tiers: Very Low (≤0.30), Low (0.31–0.45), Moderate (0.46–0.60), High (0.61–0.70), Very High (>0.70). These thresholds follow natural breaks in the Kharkhoda distribution and assist programme prioritization (Ohlan, 2013; Lallianthanga & Sailo, 2013).

Results

Indicator Set and Weights

Table 1.1. Indicator definitions, norms and weights used in VUAI

Indicator (k)	Variable used	Norm base	Normalisation rule	Weight
Drinking water	LPCD	40 LPCD	$I_{v,\text{water}} = \min(1, \text{LPCD}_v/40)$	0.20
Banks	Count of bank branches/co-ops	1/10,000	$\min(1, (S \times 10000)/P)$	0.10
Post office	Count	1/15,000	$\min(1, (S \times 15000)/P)$	0.10
Parks	Count	1/5,000	$\min(1, (S \times 5000)/P)$	0.10
Playgrounds	Count	1/5,000	$\min(1, (S \times 5000)/P)$	0.10
Community centres	Count	1/5,000	$\min(1, (S \times 5000)/P)$	0.10
Veterinary	Hosp, Disp	1 unit/5,000*	$\min\left(1, \left((H + 0.5D) \times 5000\right)/P\right)$	0.10
Bus queue shelter	Presence	-	1 if present, else 0	0.10
Police facility	Presence	1/50,000	1 if PS/chowki present in village	0.05
Petrol pump	Presence	-	1 if present, else 0	0.05

***Equivalency unit: Hospital = 1.0; Dispensary = 0.5., *Sources:* URDPFI (2015); RADPFI (2017); NBC (2005); NRDWP (2013); Primary survey (2019).**

Facility Availability by Village

Table 1.2. Selected civic and mobility utilities by village (counts/presence, 2019)

**Legend-Bank, Post: counts; Park, Playground, Community centre: counts; Vet (Eq.): hospital + 0.5 × dispensary; Bus, Police, Petrol: presence (1/0).

No.	Village	Pop 2019	Bank	Post	Park	Play	Comm	Vet (Eq.)	Bus	Police	Petrol
1	Anandpur	1,245	0	0	0	0	0	0.5	1	1	1
2	Ashrafpur Matindu	2,917	0	1	0	0	1	0.5	0	0	0
3	Barona	5,005	0	1	0	1	2	0.5	1	0	0
4	Bidhlan	3,470	0	1	0	0	2	0.5	0	0	0
5	Chhanauli	1,218	0	0	0	2	0	0	1	0	0
6	Farmana	7,582	4	1	0	0	0	1.0	0	1	1
7	Fatehpur	1,474	0	0	0	1	0	0	0	0	0
8	Firozpur Bangar	3,498	1	0	0	0	1	0.5	0	0	0

9	Garhi Sisana	4,561	0	0	0	0	0	1.0	1	0	0
10	Gopalpur	3,866	0	1	0	0	0	0	0	0	0
11	Gorar	5,198	0	1	0	0	0	0.5	0	0	0
12	Jataula	2,296	0	0	0	0	0	0	0	0	0
13	Jharoth	2,015	0	1	0	0	2	0	0	0	0
14	Jharothi	1,705	0	0	1	1	0	0	0	0	0
15	Kanwali	2,614	0	1	0	1	0	1.0	1	0	0
16	Khanda	10,088	2	1	0	0	0	1.0	0	0	1
17	Kharkhoda (MC)	29,870	5	2	4	2	1	0	1*	1	1
18	Kheri Dahiya	2,510	0	0	0	0	0	0	1	0	0
19	Khurampur	1,466	0	0	0	0	1	0	0	0	0
20	Kiroli	379	0	1	0	0	0	2.0	1	0	0
21	Kundal	2,909	1	0	0	0	1	0	1	0	0
22	Mandaura	3,782	0	0	0	0	0	0	0	0	0
23	Mandauri	2,508	0	0	0	0	0	0	0	0	0
24	Maujam Nagar	732	0	0	0	0	0	0	0	0	0
25	Nakloi	1,913	0	0	0	0	2	0	0	0	0
26	Nasirpur Cholka	2,509	0	0	0	1	0	0	0	0	0
27	Nirthan	872	0	0	0	0	0	0	1	0	0
28	Nizampur Khurd	2,214	0	0	0	0	0	0	1	0	0
29	Nizampur Majra	3,232	0	0	0	0	1	0	0	0	0
30	Pahladpur	3,353	0	0	0	0	0	0	0	0	0
31	Pai	2,413	0	0	1	0	2	0.5	0	0	0
32	Pipli	4,169	1	1	0	1	0	0	1	0	0
33	Rampur	3,362	0	1	0	1	1	0	0	0	0
34	Ridhau	3,770	0	0	0	1	1	0.5	0	0	0
35	Rohat	4,887	2	1	0	1	0	0.5	1	0	0
36	Rohna	7,098	1	1	1	0	0	1.5	0	0	1
37	Saidpur	4,186	2	1	0	1	0	0.5	1	1	0
38	Sehri	3,005	1	1	0	1	0	0.5	0	0	0
39	Silana	5,683	1	1	0	1	0	0.5	1	0	0
40	Sisana	10,987	3	1	0	1	1	1.0	1	0	1
41	Sohti	3,278	1	1	0	0	2	0.5	0	0	0
42	Thana Kalan	4,655	0	1	0	1	0	1.0	1	0	0
43	Thana Khurd	3,240	0	0	0	0	0	0	0	0	0
44	Turakpur	1,474	0	0	0	0	0	0	0	0	0

***Kharkhoda MC has a bus stand (counted as presence = 1)., *Sources: Primary survey (2019); facility lists; Figures 1.1-1.9 (banks, post offices, parks, playgrounds, community centres, police facilities, petrol pumps, veterinary services).**

The spatial clustering observed in Figures 1.1-1.9 reinforces Table 1.2. Bank branches concentrate in Kharkhoda MC, Sisana, Farmana, Khanda and main road-side villages (Figure 1.1). Post offices are widely distributed but absent from about half the villages (Figure 1.2). Parks are scarce outside Kharkhoda MC (Figure 3.26), while playgrounds dot many villages (Figure 1.7). Community centres are relatively dense in Barona, Bidhlan, Sohti, Pai and Jharoth (Figure 1.8). Veterinary facilities show both hospitals and dispensaries, with higher intensity around Kiroli, Sisana, Rohna and Farmana (Figure 1.9). Petrol pumps are linear along major routes (Kharkhoda MC, Khanda, Sisana, Rohna, Farmana, Anandpur; Figure 1.4). Police presence is point-like (Kharkhoda PS, Farmana PS; Anandpur and Saidpur chowkies; Figure 1.5).

Drinking Water Adequacy

Table 1.3. Drinking water availability by village (LPCD)

No.	Village	LPCD	No.	Village	LPCD
1	Rohna	55	23	Turakpur	55
2	Farmana	50	24	Thana Kalan	55
3	Nizampur Majra	50	25	Jataula	40
4	Ridhau	50	26	Nasirpur Cholka	50
5	Maujam Nagar	50	27	Garhi Sisana	70
6	Gorar	55	28	Chhanauli	55
7	Nakloi	50	29	Firozpur Bangar	55

8	Nirthan	40	30	Nizampur Khurd	55
9	Kheri Dahiya	50	31	Saidpur	40
10	Bidhlan	50	32	Kundal	40
11	Silana	55	33	Sohti	50
12	Sehri	50	34	Pahladpur	40
13	Khanda	70	35	Pai	44
14	Jharothi	50	36	Ashrafpur Matindu	50
15	Rohat	55	37	Sisana	55
16	Fatehpur	50	38	Kharkhoda (MC)	50
17	Mandaura	50	39	Pipli	55
18	Mandauri	50	40	Gopalpur	40
19	Jharoth	55	41	Barona	41
20	Anandpur	55	42	Khurampur	50
21	Kanwali	55	43	Kiroli	40
22	Thana Khurd	55	44	Rampur	40

Source: PHESD Kharkhoda (2019).

All villages meet or exceed the 40 LPCD benchmark (Table 1.3), so $I_{v,\text{water}} = 1$ across the block. Drinking water, while vitally important, is not the differentiating constraint in Kharkhoda in 2019; other amenities drive disparities.

Village-Level Utility Access Index (VUAI): Scores and Tiers

Using the rules in (Indicators, Normalisation and Weights), we compute indicator adequacies and aggregate to VUAI. Complete village-wise results appear in Table 1.4.

Table 1.4. VUAI by village

No.	Village	VUAI	Tier
1	Anandpur	0.50	Moderate
2	Ashrafpur Matindu	0.49	Low–Moderate
3	Barona	0.65	High
4	Bidhlan	0.47	Low–Moderate
5	Chhanauli	0.40	Low
6	Farmana	0.57	Moderate
7	Fatehpur	0.30	Very Low
8	Firozpur Bangar	0.47	Low–Moderate
9	Garhi Sisana	0.40	Low
10	Gopalpur	0.30	Very Low
11	Gorar	0.35	Very Low–Low
12	Jataula	0.20	Very Low
13	Jharoth	0.40	Low
14	Jharothi	0.40	Low
15	Kanwali	0.60	Moderate
16	Khanda	0.50	Moderate
17	Kharkhoda (MC)	0.72	Very High
18	Kheri Dahiya	0.30	Very Low
19	Khurampur	0.30	Very Low
20	Kiroli	0.50	Moderate
21	Kundal	0.50	Moderate
22	Mandaura	0.20	Very Low
23	Mandauri	0.20	Very Low
24	Maujam Nagar	0.20	Very Low
25	Nakloi	0.30	Very Low
26	Nasirpur Cholka	0.30	Very Low
27	Nirthan	0.30	Very Low
28	Nizampur Khurd	0.30	Very Low
29	Nizampur Majra	0.30	Very Low
30	Pahladpur	0.20	Very Low
31	Pai	0.50	Moderate
32	Pipli	0.60	Moderate
33	Rampur	0.50	Moderate

No.	Village	VUAI	Tier
34	Ridhau	0.47	Low–Moderate
35	Rohat	0.65	High
36	Rohna	0.62	High
37	Saidpur	0.71	Very High
38	Sehri	0.58	Moderate
39	Silana	0.63	High
40	Sisana	0.69	High
41	Sohti	0.58	Moderate
42	Thana Kalan	0.60	Moderate
43	Thana Khurd	0.20	Very Low
44	Turakpur	0.20	Very Low

see (*Indicators, Normalisation and Weights*) Underlying counts: Table 1.2; water: Table 1.3. Rounding to two decimals for reporting.

Two settlements fall in Very High access (Kharkhoda MC, Saidpur), five in High (Barona, Rohat, Rohna, Silana, Sisana), eleven Moderate (e.g., Kanwali, Pipli, Thana Kalan), six Low–Moderate (Bidhlan, Firozpur Bangar, Ridhau, Ashrafpur Matindu, etc.) and twenty in Very Low access. The skew reflects the concentration of multiple utilities in the block headquarters, large roadside villages and a handful of service nodes, versus sparse amenities in small peripheral hamlets.

What Drives High and Low VUAI?

High and very high access.

(1) Kharkhoda MC (0.72). Anchored by multiple banks, two post offices, four parks, two playgrounds, a community centre, bus stand, police station and petrol pump, the MC accumulates high scores across many dimensions; water adequacy is met (Figure 1.1-1.6; 1.5; 1.4).
(2) Saidpur (0.71). Gains come from banks (2), post office, playground, bus shelter, police chowki and a veterinary dispensary; adequacy is sustained by mid-range population (Table 1.2; Figures 1.1, 1.2, 1.6, 1.5).
(3) Barona, Rohat, Rohna, Silana, Sisana (0.63–0.65). These villages combine banks/post offices with at least one of: playground, bus shelter, veterinary presence, petrol pump (Rohna, Sisana) or park (Rohna) and community centres (Sisana) (Figures 1.1, 1.2, 1.6-1.9; 1.4).

Persistently low access.

Very low scores (≤0.30) generally reflect *only* water adequacy without sufficient civic amenities. Examples include Jataula, Mandaura, Mandauri, Maujam Nagar, Pahladpur, Turakpur and several tiny settlements. Here, even a single facility (e.g., a community centre or bus shelter) would immediately lift the index given small denominators. This pattern highlights the "first utility effect"-the first bank/post/park has a disproportionately large impact on village adequacy in small populations (URDPFI, 2015; Sarkar, 2018).

Priority Gaps by Dimension

Below Table 1.5 aggregates "deficits" at indicator level-counting villages with zero adequacy for each dimension.

Table 1.5. Indicator-wise village deficits (count of villages with adequacy = 0)

Indicator	Villages with zero adequacy (n of 44)	Comment
Drinking water	0	All meet 40 LPCD (Table 1.3).
Banks	31	Banks cluster along SH-18/SH-20 and MC; large white spaces elsewhere (Figure 1.1).
Post office	24	Coverage good but not universal; village-level "last-mile" gaps persist (Figure 1.2).
Parks	40	Parks are highly urban-concentrated (MC) with only Pai, Rohna, Jharothi outside (Figure 1.7).
Playgrounds	27	Widely present but uneven; low in tiny hamlets (Figure 1.6).
Community centres	30	Concentrations in Barona, Bidhlan, Pai, Sohti, Jharoth; many villages lack a hall (Figure 1.8).
Veterinary	25	Hospitals/dispensaries cover corridors around Kiroli–Sisana–Rohna–Farmana (Figure 1.9).
Bus queue shelter	29	Shelters at Sisana (3), Kheri Dahiya (2), Kiroli (2) and scattered elsewhere.
Police facility	40	Only Kharkhoda PS, Farmana PS; Anandpur and Saidpur chowkies (Figure 1.5).
Petrol pump	38	Only MC, Anandpur, Farmana, Khanda, Rohna, Sisana (Figure 1.4).

Parks and *community centres* are the most pervasive social-infrastructure gaps; *banks* and *post offices* show corridor bias; *bus shelters* need systematic coverage; *petrol pumps* and *police facilities* are intentionally sparse and better addressed through proximity/distance analysis at cluster scale (URDPFI, 2015; Jain, Kushwaha & Agarwal, 2017).

Discussion

Using VUAI for Micro-Level Planning

The VUAI permits block officials to prioritise *villages* rather than only clusters. For example, Jataula, Mandaura, Mandauri, Maujam Nagar, Pahladpur, Thana Khurd, Turakpur (VUAI = 0.20) are immediate candidates for a first-utility package: one bus shelter, one community centre (or playground) and a post office outreach model. In Very Low villages, adding even one amenity often lifts the index from ≤0.30 to ≥0.40 due to small populations.

Aligning Interventions with Norms

Norm-linked adequacy scores make interventions auditable. For instance, Parks and Playgrounds are normed to 1/5,000. Villages in the 2,000–5,000 range need *one* asset to reach full adequacy; larger villages (e.g., Sisana approx. 11,000) need at least two playgrounds or two community centres to be norm-adequate (URDPFI, 2015; NBC, 2005). Post offices in villages over 7,500 people without coverage should be prioritised via India Post outreach counters/sub-offices (URDPFI, 2015).

Spatial Logics and Corridors

Figures 1.1-1.9 show a clear transport-corridor logic: economic utilities (banks, petrol pumps) concentrate along SH-18/20 and around Kharkhoda MC; social spaces (parks, community centres) lag outside the headquarters area. This suggests pairing *corridor-driven market investments* with *village-internal social infrastructure* to balance outcomes (Jain, Kushwaha & Agarwal, 2017; Ngereja, Liwa & Buberwa, 2018).

Decision Support and Transparency

Because each indicator is explicitly normalised and weighted, the VUAI is explainable to gram sabhas and line departments. Villages can see *why* their score is low and what specific amenity would move them up one tier. Publishing village scorecards and amenity wish-lists fosters co-production and accountability (Rao, 2012; Bhandari, Panwar & Saklani, 2016; Alajangi et al., 2016).

Policy Directions

(1) Kharkhoda MC (Very High, 0.72): Maintain parks/playgrounds; extend social spaces to peri-urban fringes where population is growing; ensure safe, shaded bus queues at high-use intersections.
(2) Saidpur (Very High, 0.71): Strong multi-amenity basket; consider adding a community centre to reach full social adequacy and support local gatherings.
(3) Barona, Rohat, Rohna, Silana, Sisana (High, 0.63–0.69): Each needs park/green space to meet social norms; Sisana additionally requires a second playground or community hall given population ~11,000.
(4) Moderate tier villages (e.g., Kanwali, Pipli, Thana Kalan, Anandpur, Kundal, Pai, Rampur): One or two targeted additions (e.g., post office counter + bus shelter; or community centre + park) will move them into High.
(5) Very Low villages (≥20 settlements): Package approach-(i) one bus shelter; (ii) one community facility (playground or multipurpose hall); (iii) outreach post office-would be transformational. Small populations mean rapid adequacy gains at modest cost (URDPFI, 2015; RADPFI, 2017).

Limitations and Extensions

(1) Distance/proximity not modelled: Presence was measured *within* village boundaries. Future work should incorporate nearest-facility distance and service catchments (e.g., police, petrol, banks), leveraging road network travel times (Jain, Kushwaha & Agarwal, 2017; Lallianthanga & Sailo, 2013).
(2) Weights: Fixed weights reflect policy judgment. Participatory re-weighting (e.g., higher weight on bus shelters for student mobility) can customise the index (Rao, 2012).
(3) Temporal dynamics: The analysis is for 2019. Updating the VUAI periodically makes it a monitoring tool.

Conclusion

Measuring village-level utility access with transparent, norm-linked indicators converts long facility lists into actionable priorities. In Kharkhoda, drinking water adequacy is universal but social spaces (parks/community centres) and basic civic/mobility nodes (bus shelters, post offices, banks) are uneven, producing wide dispersion in access: two settlements are very well served, five are high, eleven moderate, while twenty villages remain in the very-low tier. The proposed VUAI provides a defensible, reproducible basis for micro-level

planning, enabling the block to target first-utilities to lagging villages and social spaces to balance corridor-driven growth. Because the method is simple and auditable, it can be scaled across blocks and embedded in routine planning reviews.

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