Spatial and Multilevel Analysis of Grid Electricity Availability in Somaliland using SIHBS 2023

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Abstract: This study examines the spatial and multilevel analysis of grid electricity availability in Somaliland, a setting characterized by regional disparities in electricity access. Using a quantitative cross-sectional design, the analysis draws on data from the 2023 Somaliland Integrated Household Budget Survey (SIHBS), encompassing 2,703 households. Spatial statistical techniques including Moran's I and Getis-Ord Gi* hot spot analysis, are combined with multilevel logistic regression to identify the factors associated with access to reliable 24-hour grid electricity.

The spatial analysis reveals a east–west divide in electricity availability. Statistically significant clusters of high access ("hot spots") are concentrated in the western regions of Awdal and Maroodi Jeex, while clusters of low access ("cold spots") are predominantly located in the eastern regions of Sanaag and Sool. These spatial disparities are further substantiated by the multilevel regression results. Once community-level clustering is accounted for, household-level socioeconomic characteristics do not emerge as significant predictors of electricity access. Instead, access is overwhelmingly shaped by community-level determinants, with urban residence and administrative region identified as the only statistically significant predictors.

This finding is strongly reinforced by an exceptionally high intra-class correlation coefficient (ICC) of 0.951, indicating that approximately 95% of the variation in access to reliable electricity is attributable to differences between communities rather than differences among households within the same community. Collectively, these results demonstrate that electricity access in Somaliland is fundamentally a supply-side phenomenon, driven by infrastructure placement and geographic factors, rather than a demand-side outcome determined by household economic characteristics.

The study provides robust, spatially explicit evidence with direct policy relevance for achieving Sustainable Development Goal 7. It underscores the urgency of geographically targeted investments in underserved "cold spot" regions and the development of comprehensive rural electrification strategies to address entrenched regional inequalities in energy access across Somaliland.

Index terms: Electricity access, multilevel modelling, spatial analysis, Sustainable development goals, Somaliland

1. Introduction

Global electricity demand is rising rapidly, with a 2.5% increase recorded in 2023, primarily driven by industrial electrification and growing consumer demand for household appliances and cooling systems [1]. Residential electricity consumption (REC) is closely linked to economic development, with higher consumption typically correlating with increased income, improved health outcomes, and enhanced educational attainment [2–4]. According to the International Energy Outlook, REC is projected to grow at 3.2% per annum, particularly in large developing economies such as India and China [5].

However, unsustainable electricity consumption presents significant environmental and social challenges, contributing to greenhouse gas emissions, energy insecurity, and worsening socioeconomic disparities [2,6]. The residential sector, which accounts for over 20% of global electricity demand, is a critical area for promoting sustainable energy consumption [7]. Household electricity use is influenced by demographic and socio-economic factors, including family size, age, and educational attainment of the household head. Larger households, especially those with young children, typically consume more electricity due to higher demand for lighting, heating, and appliance use [8,9].

Access to electricity remains a major challenge in many African countries. While electrification rates have improved in some regions, rural areas still face significant deficits, prompting initiatives for decentralized solutions such as solar home systems and mini-grids [10,11]. In 2022, global electricity access reached 91%, yet 685 million people remained without electricity, with Sub-Saharan Africa accounting for 83% of the deficit. Annual progress slowed to 0.4% between 2020 and 2022, well below the required 1.08% annual increase needed to achieve universal access by 2030 [1].

Electricity access is not only about availability but also reliability. Unreliable grids, characterized by frequent outages, reduce the potential benefits of electrification, affecting household welfare and business productivity while increasing the cost of grid extension [12]. In Sub-Saharan Africa, grid electrification remains low at approximately 35%, with rural areas as low as 15%, compared to 69% in urban centers [13]. North Africa, in contrast, has achieved near-universal access.

Access to reliable, affordable, and sustainable electricity is essential for modern economic and social development. It is an enabler of poverty reduction, industrialization, and gender equality [14]. This study aligns with Sustainable Development Goal (SDG) 7, which seeks to "Ensure access to affordable, reliable, sustainable and modern energy for all" by 2030. Understanding the determinants of household electricity consumption is crucial for designing targeted interventions that promote equitable access and energy efficiency, particularly in regions facing rapid population growth and urbanization, such as East Africa

2. Materials and Methods

2.1 Study area

The study was conducted in Somaliland, a region in the Horn of Africa, comprising six administrative regions: Awdal, Maroodi Jeex, Togdheer, Sool, Saaxil, and Sanaag. The study area encompasses both urban and rural settlements, allowing comprehensive geographic coverage for assessing household electricity access.

2.2 Study Design

A cross-sectional analytical design was used, employing secondary survey data from SIHBS 2023. The hierarchical structure of households nested within Enumeration Areas (EAs) justified the use of multilevel modeling to examine both household- and community-level determinants of grid electricity availability.

2.3 Data Source

Data were obtained from the Somaliland Integrated Household Budget Survey (SIHBS) 2023. This nationally representative survey collects detailed information on household demographics, socioeconomic status, housing conditions, consumption, and access to essential services, including electricity. The survey included geo-referenced data for EAs, enabling spatial analysis.

A multi-stage stratified cluster sampling approach was applied. The sampling frame was stratified by region and urban/rural status. EAs were selected as primary sampling units, and households within EAs were systematically sampled. After applying the inclusion criteria, the final sample comprised 2,748 households within 116 EAs. Households with missing data on the primary outcome or key predictors were excluded.

2.4 Study Variables

The dependent variable, grid electricity reliability, was coded as limited access (<12 hours/day) or full access (12–24 hours/day). Independent variables were structured at two levels. Household-Level Variables (Level: Age, sex, education, and marital status of the household head, internet use, housing type, main water source, sanitation facility, and main cooking fuel) and Community-Level Variables(Place of residence (urban/rural) and region (Awdal, Maroodi Jeex, Saaxil, Togdheer, Sanaag, Sool).

2.5 Data Management and Statistical Analysis

Data management and cleaning were conducted using Stata. Household member and household datasets were merged, key variables recoded, and missing values handled through listwise deletion. Analysis proceeded in three stages: (1) descriptive statistics to summarize household and community characteristics, (2) bivariate analysis to explore associations with electricity access, and (3) multilevel logistic regression to model determinants at household and community levels. Spatial analyses of electricity access patterns were conducted using R.

2.6 Ethical Statement

This study used publicly available, de-identified secondary data. Ethical approval was obtained by the SIHBS survey administrators. No individual-level consent was required for this analysis, and all data were handled in accordance with confidentiality and data protection standards.

3. Results

The study sample comprised 2,703 households. Key socio-demographic characteristics are summarized in Table 1. The majority of households (91.5%) reported having access for 24 hours, while a smaller portion (8.5%) reported limited access (1-12 hours).The sample was predominantly urban (91.0%), with a relatively even distribution across Somaliland. A significant majority of households lived in permanent/formal housing (92.8%) and owned their dwelling (89.5%). Most households had access to improved sanitation facilities (78.5%) and improved drinking water sources (64.7%). However, a large proportion still relied on solid/non-clean cooking fuels (70.3%).

Majority of respondents were female (56.1%). The largest age group was under 20 years (35.9%), and a significant portion had never been married (60.3%). Over 71% of respondents reported having attended school at some point

Table 1: Individual and community-level factors

Variable Name	Category	Frequency	Percent (%)
Grid Connection	0–12 hrs	229	8.47
	24 hrs	2,474	91.53
Age of Household Head	<20 years	970	35.89
	20–29 years	484	17.91
	30–39 years	578	21.38
	40–49 years	178	6.59
	50–59 years	144	5.33
	60+ years	349	12.91
Housing Type	Temporary/Informal/Basic	195	7.21
	Permanent/Formal	2,508	92.79
Toilet Facility	Unimproved	580	21.46
	Improved	2,123	78.54
Drinking Water Source	Unimproved	955	35.33
	Improved	1,748	64.67
Electricity Access	Yes	2,703	100.00
House Ownership	Yes (HH member owns)	2,418	89.46
	No (non-HH member)	285	10.54
Internet Use (3 months)	Yes	1,399	51.76
	No	1,304	48.24
School Attendance	Yes	1,924	71.18
	No	779	28.82
Marital Status	Married	829	30.67
	Divorced	96	3.55
	Never married	1,629	60.27
	Widowed	149	5.51
Sex of Household Head	Male	1,186	43.88
	Female	1,517	56.12
Cooking Fuel Type	Solid/Non-Clean	1,899	70.26
	Clean	804	29.74
Residence Type	Rural	243	8.99
	Urban	2,460	91.01
Region	Awdal	514	19.02
	Maroodi Jeex	453	16.76
	Sahil	384	14.21
	Sanaag	479	17.72
	Sool	469	17.35
	Togdheer	404	14.95

3.1 Spatial Analysis Result

Sool and Sanaag exhibit the lowest grid coverage, with proportions ranging between 0.13 and 0.20 (see Figure), reflecting limited access to electricity for a large portion of their population. Awdal and Maroodijeex**,** show higher proportions of grid connection, typically between 0.027 and 0.045**,** indicating comparatively greater access.

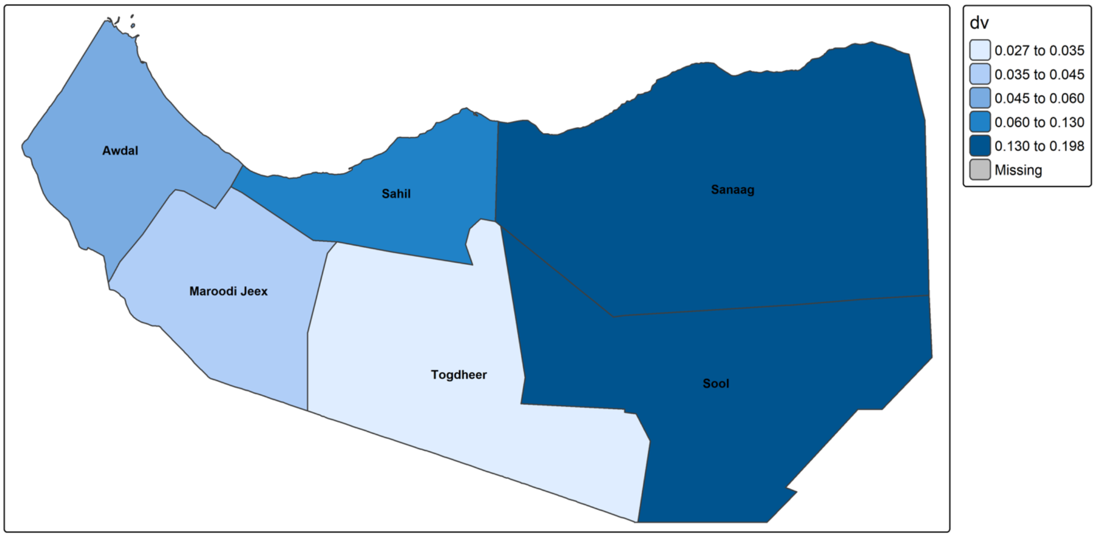

Figure1: Spatial distribution of grid electricity availability

The Global Moran's I statistic was used to test whether the pattern of grid electricity availability was clustered, dispersed, or random across Somaliland. The analysis yielded a Moran's Index of 0.09841, with a z-score of 1.44301 and a p-value of 0.074509 (Figure). Since the p-value is less than the significance level of 0.10, we reject the null hypothesis of a random spatial distribution at a 90% confidence level.

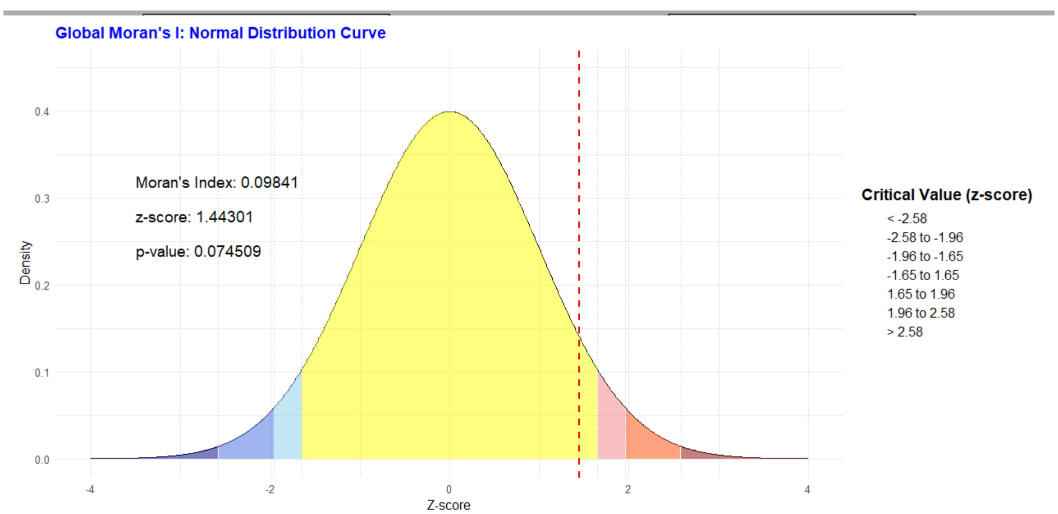

Figure 3: Global Moran's I for Grid Electricity Availability

The Getis-Ord Gi* analysis (Z-score map) identified statistically significant hot spots (clusters of high availability, Z-score ≥ 1.65) concentrated primarily in the western and central regions, including Awdal, Maroodi Jeex, and Togdheer (see

Figure). Conversely, cold spots (clusters of low availability) were predominantly found in the eastern regions of Sanaag and Sool.

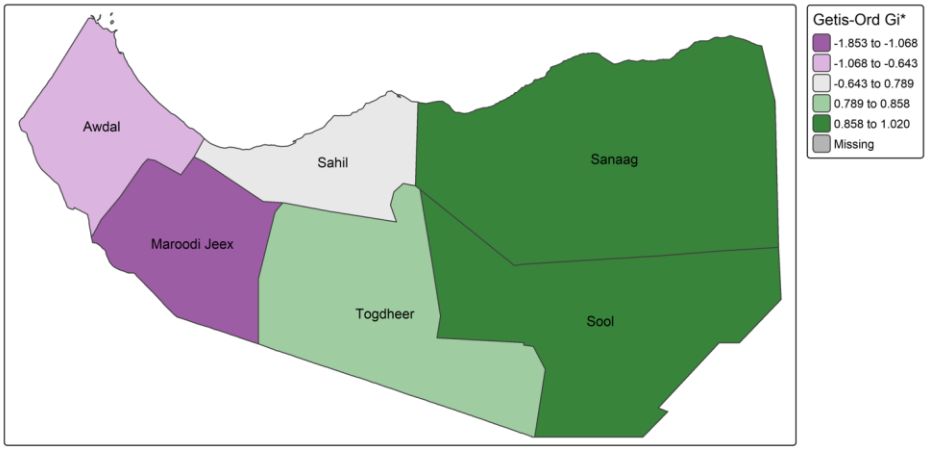

Figure 4: Getis-Ord Gi for Grid Electricity Availability

A bivariate analysis was conducted to evaluate the association between various household characteristics and grid connection availability (0-12 hours vs. 24 hours) over the past seven days. Demographic variables such as age of the household head ($\chi^2 = 5.39$, $p = 0.371$), marital status ($\chi^2 = 3.71$, $p = 0.295$), and sex of the household head ($\chi^2 = 1.97$, $p = 0.161$) did not show statistically significant associations with grid access. Similarly, housing type ($\chi^2 = 0.19$, $p = 0.662$), drinking water source ($\chi^2 = 0.91$, $p = 0.340$), household ownership ($\chi^2 = 0.03$, $p = 0.874$), internet use ($\chi^2 = 1.72$, $p = 0.190$), school attendance ($\chi^2 = 0.04$, $p = 0.849$), and cooking fuel category ($\chi^2 = 0.91$, $p = 0.339$) were not significantly associated with the duration of grid electricity availability.

The type of sanitation facility was strongly associated with electricity access ($\chi^2 = 81.36$, $p < 0.001$). Households with unimproved sanitation facilities reported limited grid access (0-12 hours) at a much higher rate (17.58%) than those with improved facilities (5.92%). A significant disparity was observed between rural and urban areas ($\chi^2 = 129.85$, $p < 0.001$). Rural households were far more likely to experience limited access (27.64%) compared to urban households (6.51%). Regional differences were statistically significant ($\chi^2 = 133.22$, $p < 0.001$). Higher proportions of limited access were reported in Sanag (19.55%) and Sool (12.70%) compared to Awdal (5.13%), Marodijeh (3.49%), and Togdher (4.12%).

Table 2: Bivariate Analysis of Predictor Variables by Grid Connection Availability (Last 7 Days)

Variable with categories	0-12hrs	24 hrs	Total	Chi2	p-value
Age_HH (Age in completed years)				5.39	0.371
<20 years	71 (7.23%)	911 (92.77%)	982		
20-29 years	43 (8.81%)	445 (91.19%)	488		
30-39 years	59 (10.00%)	531 (90.00%)	590		
40-49 years	20 (10.58%)	169 (89.42%)	189		
50-59 years	11 (7.48%)	136 (92.52%)	147		
60+ years	27 (7.67%)	325 (92.33%)	352		
Housing Type Category				0.19	0.662
Temporary/Informal/Basic	15 (7.58%)	183 (92.42%)	198		
Permanent/Formal	216 (8.47%)	2,334 (91.53%)	2,550		
Sanitation Facility Category				81.36	<0.001
Unimproved	103 (17.58%)	483 (82.42%)	586		
Improved	128 (5.92%)	2,034 (94.08%)	2,162		
Drinking Water Source Category				0.91	0.340
Unimproved	88 (9.09%)	880 (90.91%)	968		
Improved	143 (8.03%)	1,637 (91.97%)	1,780		
HH Ownership				0.03	0.874
Yes (Owned by HH member)	207 (8.44%)	2,247 (91.56%)	2,454		
No (Owned by non-HH member)	24 (8.16%)	270 (91.84%)	294		

Internet Use (Last 3 months)				1.72	0.190
Yes	110 (7.74%)	1,312 (92.26%)	1,422		
No	121 (9.13%)	1,205 (90.87%)	1,326		
School Attendance (Ever)				0.04	0.849
Yes	163 (8.34%)	1,791 (91.66%)	1,954		
No	68 (8.56%)	726 (91.44%)	794		
Marital Status				3.71	0.295
Married	82 (9.67%)	766 (90.33%)	848		
Divorced	10 (10.20%)	88 (89.80%)	98		
Never married	125 (7.58%)	1,523 (92.42%)	1,648		
Widowed	14 (9.09%)	140 (90.91%)	154		
Sex of Household Member				1.97	0.161
Male	91 (7.56%)	1,112 (92.44%)	1,203		
Female	140 (9.06%)	1,405 (90.94%)	1,545		
Residence (Enumeration Area Type)				129.85	<0.001
Rural	68 (27.64%)	178 (72.36%)	246		
Urban	163 (6.51%)	2,339 (93.49%)	2,502		
Region				133.22	<0.001
Awdal	27 (5.13%)	499 (94.87%)	526		
Marodijeh	28 (3.49%)	775 (96.51%)	803		
Togdher	18 (4.12%)	419 (95.88%)	437		
Sool	63 (12.70%)	433 (87.30%)	496		
Sanag	95 (19.55%)	391 (80.45%)	486		
Cooking Fuel Category				0.91	0.339
Solid/Non-Clean	169 (8.73%)	1,766 (91.27%)	1,935		
Clean	62 (7.63%)	751 (92.37%)	813		
Total	231 (8.41%)	2,517 (91.59%)	2,748		

3.2 Multilevel Logistic Regression Analysis

The multilevel logistic regression analysis progressively models the likelihood of grid electricity availability by incorporating individual and community-level factors. The consistently high Intra-Class Correlation (ICC) across all models (0.95) in the empty model, reducing to 0.909 in the full model. strongly indicates that a substantial proportion of the variance in grid electricity availability is attributable to differences between communities, justifying the use of a multilevel approach. The Likelihood Ratio (LR) tests, all highly significant (p<0.001), further confirm that these multilevel models provide a statistically superior fit compared to standard logistic regression models that would ignore this clustering. Model 3, the full model incorporating both individual and community-level predictors, is identified as the best-fitting model based on its lower AIC (849.51) and BIC (891.95) values, alongside a significant Wald chi-squared statistic (23.23, p<0.001), suggesting it offers the most comprehensive explanation of the observed variance.

Examining the fixed effects in the full model (Model 3), the most striking determinant of grid electricity availability is urban residence. Households in urban areas have astronomically higher odds (log-odds = 376.17, p<0.001) of having grid electricity compared to rural households, highlighting a profound urban-rural disparity. Regional variations also play a role; specifically, households in Sool exhibit statistically significantly higher odds (log-odds = 0.07, p<0.05) of having electricity access compared to the Awdal Region, though the magnitude of this effect is modest (Odds Ratio ≈ e^0.07 ≈ 1.07, or 7% higher odds). Other regions (Region 2, Region 3, Region 5) did not show statistically significant differences in electricity availability compared to the reference region after controlling for other factors.

At the individual level, the presence of an improved toilet facility was associated with increased odds of having grid electricity (log-odds = 1.12, OR ≈ 3.06 in Model 3), suggesting households with improved sanitation are over three times more likely to have electricity. However, this association did not reach statistical significance in the full model. The random effects variance at the community level (_cons) substantially decreased from 64.24 in the empty model to 32.99 in the full model. This reduction indicates that the community-level variables included (residence type, region) explain a significant portion of the between-community variance. The remaining ICC of 0.909 in the full model signifies that considerable unexplained variation in grid electricity availability still exists at the community level, pointing towards other unmeasured community characteristics influencing access

Table 3: Multilevel Logistic Regression Analysis of Individual- and Community-Level Factors Associated with DV

Variable / Model	Model 0 (Empty)	Model 1 (Individual)	Model 2 (Community)	Model 3 (Full Model)

Fixed Effects				
Toilet: Improved		1.17 (0.35)	—	1.12 (0.34)
Residence: Urban			393.89 (531.33) ***	376.17 (505.07) ***
Marodijeh			1.47 (2.35)	1.46 (2.32)
Togdher			0.11 (0.18)	0.11 (0.18)
Sool			0.07 (0.11) *	0.07 (0.11) *
Sanag			0.16 (0.26)	0.16 (0.26)
Random Effects (wgt)				
Variance (_cons)	64.24	62.95	33.19	32.99
Model Fit Statistics				
Log Likelihood	-426.54	-426.37	-417.91	-417.76
AIC	857.07	858.74	849.83	849.51
BIC	868.91	876.50	891.26	891.95
ICC (Intra-Class Correlation)	0.951	0.950	0.910	0.909
Wald chi² (df)	—	0.27 (1)	22.75 (5) ***	23.23 (6) ***
LR test vs. logistic model	732.95 ***	664.06 ***	561.58 **	559.91 **

4. Discussion

This study aimed to identify spatial and multilevel factors associated with grid electricity availability in Somaliland. The findings highlight significant disparities driven primarily by geographic location (urban versus rural, and regional differences).

The most interesting finding is the profound urban-rural divide in grid electricity availability. Urban households were overwhelmingly more likely to have 24-hour access compared to their rural counterparts. This aligns with global trends where electricity infrastructure is often concentrated in urban centers due to higher population density, economic activity, and perceived return on investment (IEA, 2022a; Rosnes & Vennemo, 2012). This disparity directly impacts SDG 7's goal of universal access, suggesting that rural populations in Somaliland are significantly underserved, limiting opportunities for education, healthcare, and economic development that rely on consistent electricity.

Regional variations also emerged, with trends shows that regions Sool and Sanag may face greater challenges in electricity access compared to Marodijeh or Awdal. These regional disparities are consistent with the high ICC, indicating that the context (region or enumeration area) in which a household is located is a dominant determinant of electricity access. Such disparities can be attributed to factors like remoteness, lower population densities making grid extension economically challenging, historical development patterns, and potentially ongoing security or governance challenges in certain areas (Blodgett et al., 2017).

Interestingly, while the type of sanitation facility was significant in the bivariate analysis, its effect diminished and became non-significant in the final multilevel model once urban-rural and regional factors were controlled. This suggests that sanitation might be a proxy for broader infrastructural development, which is largely captured by the urban-rural and regional variables. Households in better-served (often urban) areas are likely to have both improved sanitation and better electricity access, but the direct link between sanitation type and electricity access itself is weak when these powerful geographical confounders are considered.

The nearly universal reported access to some form of electricity (100%) initially seems positive, but the crucial finding is the variability in grid reliability (91.59% with 24-hour grid access vs. 8.41% with limited access). This 8.41% with limited grid access, predominantly in rural areas and specific regions, likely rely on more expensive, less reliable, or more polluting alternative sources for lighting and other needs, such as kerosene lamps, candles, or small generators. This has direct implications for household expenditure, health (indoor air pollution), and safety.

The study's findings underscore that achieving SDG 7 in Somaliland requires a spatially targeted approach. The high ICC and MOR values emphasize that policies must address the systemic, geographically-bound factors that create these deep inequalities in electricity access. Simply focusing on individual household characteristics without addressing the broader infrastructural and regional context will likely be insufficient.

5. Conclusion

This study provides a comprehensive spatial and multilevel analysis of grid electricity availability in Somaliland, revealing both geographical and community-level disparities. The spatial analysis demonstrated a clear divide: hot spots of high electricity availability were concentrated in western and central regions, particularly Awdal, Maroodi Jeex, and Togdheer, while cold spots were predominantly located in the eastern regions of Sanaag and Sool. These patterns reflect broader trends in Sub-Saharan Africa, where infrastructure development tends to cluster around economic and political centers, leaving remote and historically marginalized areas underserved (Chirambo, 2018; Dora et al., 2025). The weak global clustering alongside strong local clustering underscores that electricity access in Somaliland is not uniform but regionally distinct.

At the household level, the multilevel analysis revealed that individual or socio-economic characteristics—such as age, sex, education, housing type, or internet use—were not significant determinants of electricity availability. While bivariate analysis initially suggested some associations, these disappeared once community-level clustering was accounted for. This contrasts with findings from other contexts (Kostakis, 2020; Tete et al., 2024; Tewathia, 2014), highlighting that in Somaliland, the primary constraint is the physical reliability of the grid itself. Household wealth or education cannot overcome the absence of reliable electricity, emphasizing that infrastructure availability is a prerequisite for household-level factors to influence electricity use.

Community-level factors, specifically place of residence and administrative region, emerged as the strongest predictors. Urban households were significantly less likely to experience limited electricity access compared to rural households, while residing in Sanaag or Sool substantially increased the likelihood of limited access. These results mirror the documented urban-rural energy divide in Sub-Saharan Africa and underscore the importance of regional context in shaping electricity access (Muez Ali, 2021; Poloamina & Umoh, 2013).

The exceptionally high Intra-Class Correlation Coefficient (ICC = 0.951) further emphasizes that the vast majority of variation in grid electricity availability occurs between communities rather than within them. This finding validates the multilevel modeling approach and confirms that electricity availability in Somaliland is predominantly a community-level condition rather than an individual household outcome.

Overall, this study highlights that addressing electricity access in Somaliland requires targeted infrastructure investments focused on under-served regions and rural communities. Policies aimed solely at improving household-level socio-economic conditions are unlikely to succeed unless the fundamental issue of grid reliability is addressed. Spatially-informed planning and regionally prioritized electrification programs are therefore critical for closing the electricity access gap and promoting equitable development across Somaliland.

REFERENCES

[1]IEA. Electricity Market Report 2024. International Energy Agency; 2024.

[2] Ivanova D, Stadler K, Steen-Olsen K, Wood R, Vita G, Tukker A, Hertwich EG. Environmental impact assessment of household consumption. J Ind Ecol. 2016;20(3):526–536.

[3] Qin P, Liu M, Su L, Fei Y, Tan-Soo J-S. Electricity consumption in the digital era: Micro evidence from Chinese households. Resour Conserv Recycl. 2022;182:106297.

[4] Singh J, Mantha SS, Phalle VM. Characterizing domestic electricity consumption in the Indian urban household sector. Energy Build. 2018;170:74–82.

[5] International Energy Outlook (IEO). Energy projections for developing economies. U.S. Energy Information Administration; 2021.

[6] Williams SP, Thondhlana G, Kua HW. Electricity use behaviour in a high-income neighbourhood in Johannesburg, South Africa. Sustainability. 2020;12(11):4571.

[7] Song K, Qu S, Taiebat M, Liang S, Xu M. Scale, distribution and variations of global greenhouse gas emissions driven by US households. Environ Int. 2019;133:105137.

[8] Tewathia N. Determinants of the household electricity consumption: A case study of Delhi. Int J Energy Econ Policy. 2014;4(3):337–348.

[9] Mutumbi U, Thondhlana G, Ruwanza S. The status of household electricity use behaviour research in South Africa between 2000 and 2022. Energies. 2022;15(23):9018.

[10] Rosnes O, Vennemo H. The cost of providing electricity to Africa. Energy Econ. 2012;34(5):1318–1328.

[11] Blodgett C, Dauenhauer P, Louie H, Kickham L. Accuracy of energy-use surveys in predicting rural mini-grid user consumption. Energy Sustain Dev. 2017;41:88–105.

[12] Migisha L, Mwase W, Kabera D. Reliability of electricity grids in Sub-Saharan Africa: Impacts on households and business productivity. Energy Sustain Dev. 2023;70:101–114.

[13] Dora S. Rural–urban disparities in electricity access in Sub-Saharan Africa. Renew Energy Rev. 2025;16(2):112–124.

[14] Chirambo D. Access to electricity and sustainable development in Sub-Saharan Africa. Energy Policy. 2018;115:1–9.