Availabe online at Website:
http://journal.uinjkt.ac.id/index.php/jko
Jurnal Kommunity Online, Volume 6, No 2, 2025, 186 - 199

RURAL - URBAN DISPARITIES IN DIGITAL TECHNOLOGY ACCESS IN INDONESIA: EVIDENCE FROM SUSENAS HOUSEHOLD DATA

Axellina Muara Setyanti[1*], Silvi Asna Prestianawati[1], Muhammad Fawwaz[2]
[1]University of Brawijaya, Malang, Indonesia
[2]University of Malaya, Kuala Lumpur, Malaysia
E-mail: axellinamuara@ub.ac.id

Submit : 21 April 2025, **Revisi :** 27 Oktober 2025**, Approve :** 01 Desember 2025

Abstract

This study analyzes disparities in digital technology access between rural and urban households in Indonesia using data from the National Socioeconomic Survey (SUSENAS). The research focuses on the role of household head education in shaping internet access and investigates whether this effect differs by geographic location. A binary logistic regression model is applied, incorporating an interaction term between rural and urban, also educational attainment, alongside key household socio-economic variables such as income, employment status, household size, and age. Findings reveal a persistent digital divide, with rural households significantly less likely to have internet access than their urban counterparts. Higher education levels are associated with greater digital access, but the effect is notably weaker in rural areas, suggesting that structural barriers may limit the benefits of education in these contexts. Formal employment and smaller household size are also positively associated with digital access, while older age and informal employment reduce the likelihood of connectivity. A gender-disaggregated analysis shows that female-headed households face additional disadvantages, particularly in rural areas, where gender and spatial inequalities intersect. These results highlight the need for inclusive digital development strategies that consider geographic and gender-based disparities.

Keywords*: Digital Access Disparity, Rural, Urban, SUSENAS.*

How to cite: Setyanti, A M., Prestianawati, S A., & Fawwaz M. 2025. Rural-Urban Disparities in Digital Technology Access in Indonesia: Evidence from SUSENAS Household Data. *Jurnal Kommunity Online*, 6(2), 2025, 186-199, doi:10.15408/jko.v6i2.46031

INTRODUCTION

The rapid advancement of digital technology has emerged as a pivotal catalyst in accelerating global social and economic transformations, including within Indonesia. As of 2024, Indonesia recorded approximately 221.6 million internet users, representing 79.5% of the total population of 278.7 million (Asosiasi Penyelenggara Jasa Internet Indonesia/APJII, 2024). This figure reflects a continued upward trend in internet penetration, rising from 78.1% in the previous year to the current level. The steady increase in digital connectivity illustrates

the country's ongoing digital transformation, driven by expanding mobile network coverage, growing smartphone ownership, and increasing reliance on internet-based services in daily life. However, while national-level data suggest encouraging progress, aggregate figures often obscure underlying disparities in digital access, particularly between urban and rural regions. Such gaps remain critical in assessing the inclusiveness and equity of Indonesia's digital development agenda.

Despite large-scale infrastructure initiatives, most notably the Palapa Ring project, which aims to establish nationwide broadband backbone connectivity, digital diffusion remains uneven across regions. Urban areas typically benefit from superior infrastructure, including reliable electricity, high-speed internet connectivity, educational facilities, and dense economic activities that attract technological investments (Briglauer et al., 2024; Lynn et al., 2022). Conversely, rural regions are often hampered by infrastructural deficits, geographical and social isolation, higher poverty incidence, and a predominance of informal employment sectors such as agriculture, which generally demand fewer digital competencies (McGuire et al., 2022; Schneider et al., 2023). As a result, households in rural areas frequently exhibit lower educational attainment, limited income levels, and restricted access to financial services and digital devices, reinforcing patterns of digital exclusion and constraining their ability to fully benefit from digitalization (Agwu, 2020; Sindakis & Showkat, 2024).

From a theoretical perspective, frameworks such as the Digital Divide (van Dijk, 2017) and the Social Stratification of Technology Access (Wilson et al., 2003) emphasize that digital inequalities are not solely a function of infrastructural availability, but are deeply rooted in socio-economic and demographic characteristics. Empirical studies across diverse settings have consistently shown that education, income, employment status, household composition, age, and gender play crucial roles in shaping digital access and utilization (Guo et al., 2023; van Deursen et al., 2021). Empirical evidence from various contexts further highlights how these factors interact with spatial and institutional conditions: studies in Kenya and India emphasize infrastructural and digital literacy challenges in rural areas (Kerkhoff & Makubuya, 2022; Hassan & Mirza, 2021); Raihan et al. (2024) identify barriers related to internet access, digital skills, language, and costs; Pérez-Amaral et al. (2021) document the role of age and education in Spain; while studies in Sub-Saharan Africa underscore the importance of basic infrastructure such as electricity (Tryphone et al., 2023). Additional evidence shows that age, gender, household size, and housing density significantly influence digital adoption and access quality (Elena-Bucea et al., 2021; Kansiime et al., 2022; Acilar & Sæbø, 2023).

However, existing studies largely examine these determinants in isolation or rely on descriptive comparisons between rural and urban areas, providing limited insight into whether the effect of education itself differs across spatial contexts in Indonesia. In other words, it remains empirically unclear whether higher educational attainment yields comparable improvements in digital access for rural and urban households, particularly in a setting where infrastructure expansion through initiatives such as Palapa Ring coexists with persistent socio-economic disparities. This study addresses this gap by utilizing the nationally representative SUSENAS 2022 dataset to analyze household-level digital technology access and to explicitly test the interaction between education and residential location. By employing a logistic regression model with an education × rural interaction term, this study contributes novel empirical evidence on the conditional role of human capital in shaping digital inclusion. The findings offer policy-relevant insights for Indonesia's digital transformation agenda, suggesting that infrastructure expansion alone may be insufficient unless accompanied by targeted interventions addressing socio-economic and spatial inequalities.

METHODS

This study adopts a quantitative research approach utilizing logistic regression analysis to investigate the socio-economic determinants influencing household access to digital technology in Indonesia, with a particular emphasis on disparities between rural and urban areas. Logistic regression is appropriate for this research because the dependent variable is binary in nature, representing whether or not a household has access to digital technology, specifically, internet access.

The data employed in this analysis are drawn from the 2022 National Socio-Economic Survey (SUSENAS), conducted by Indonesia's Central Bureau of Statistics (BPS). SUSENAS provides large-sample, nationally representative household-level data designed to capture social and economic conditions at the national, provincial, and district levels. The survey contains detailed information on household characteristics, including the education level of the household head, employment status, household expenditures, asset ownership, and indicators of digital access such as internet use and device ownership. In addition, SUSENAS explicitly classifies household location into rural and urban areas, which enables spatially disaggregated analysis. This feature is particularly relevant for examining interaction effects between geographic context and household characteristics, especially the interaction between education and rural–urban residence in shaping household digital access.

To empirically estimate the likelihood of digital access, a binary logistic regression model is constructed. The dependent variable captures whether a household has access to the internet, while the independent variables include key socio-economic indicators. The core of the model includes an interaction term between the household's place of residence (rural/urban) and the educational attainment of the household head, allowing for the identification of whether the effect of education on digital access varies by geographic setting.

The model specification is as follows:

$$logit(P(Y=1)) = \beta\_0 + \beta\_1\, Rural + \beta\_2\, Edu + \beta\_3\, (Rural \times Edu) + \beta\_4\, Income + \beta\_5\, Employment + \beta\_6\, HH\_Size + \beta\_7\, Age + \epsilon \quad (1)$$

In this model, the dependent variable Y is defined as a binary outcome indicating whether the household has internet access (1 = access, 0 = no access). The main explanatory variables include a binary indicator of rural residence (1 = rural, 0 = urban), the number of years of formal schooling completed by the household head (education), and an interaction term between rural and education to examine whether the effect of education on digital access varies by geographic location. Additional control variables encompass per capita household expenditure as a proxy for income, employment status of the household head (formal vs. informal), access to electricity, total household size, the gender of the household head (1 = male, 0 = female), and their age in years. These variables collectively capture the multidimensional socio-economic context that may influence household access to digital technology. The operational definitions and coding schemes for all variables used in the model are detailed in Table 1.

The descriptive analysis in Table 2 provides an initial overview of digital access conditions among Indonesian households. While internet access is becoming more common, a considerable portion of households still remain unconnected. Rural households represent a larger share of the sample, which reflects national demographics but also hints at possible geographic inequalities. These areas often experience limited infrastructure and public service delivery, potentially restricting access to digital technologies. At the same time, informal employment dominates the labor profile of household heads, a factor that may influence their capacity to invest in digital tools or services.

Table 1. Operational Definition of Variables

Variables	Definition	Category
Internet Access *(Internet)*	Indicates whether the household has access to internet services	1 = Has Access 0 = No Access
Rural-Urban Residency *(Rural)*	Identifies the household's place of residence	1 = Rural 0 = Urban
Household-head Education *(Edu)*	Number of years of formal education completed by the household head	Continuous (in year)
Household Income *(Income)*	Household income proxied by expenditure, used as a measurement for economic capacity	Continuous (in Rupiah)
Employment Status *(Employment)*	Type of employment of the household head	1 = Informal 0 = Formal
Household Size *(HH Size)*	Total number of individuals living in the household	Continuous (in person)
Household-head Age *(Age)*	Age of the household head	Continuous (in year)

Source: SUSENAS 2022, modified

Educational attainment among household heads is relatively low, with a significant concentration at the primary level or below. This could shape awareness, perceived value, and capability to use digital technology effectively. Household income varies widely, suggesting differences in economic capacity to support internet use. Meanwhile, household size adds another layer of complexity, as larger families may face different usage patterns or constraints. Together, these observations suggest that access to digital technology is shaped by multiple, intersecting household-level factors, justifying the need for further econometric investigation.

Table 2. Descriptive Statistics

Variables	Frequency	Percentage	Max	Min
Internet Access				
Yes	175,026	51.54	1	0
No	164,558	48.46	1	0
Rural-Urban Residency				
Rural	197,472	58.15	1	0
Urban	142,112	41.85	1	0
Household-head Education/ Year of Schooling				
No schooling / Did not complete primary school	62,990	18.55	-	-
Primary school or equivalent	98,941	29.14	-	-
Junior secondary school or equivalent	54,347	16.00	-	-
Senior secondary school	89,413	26.33	-	-

Variables	Frequency	Percentage	Max	Min
or equivalent				
Diploma I / II	1,603	0.47	-	-
Diploma III	4,013	1.18	-	-
Diploma IV / Bachelor's Degree (S1)	25,946	7.64	-	-
Professional Degree / Master's Degree (S2)	2,153	0.63	-	-
Doctoral Degree (S3)	178	0.05	-	-
Employment Status				
Informal	188,414	55.48	1	0
Formal	151,170	44.52	1	0
Variables	**Mean**	**Std. Deviation**	**Max**	**Min**
Household Income	1,039,874	705,028.2	52,000,000	138,983.3
Household Size	3.62	1.60	1	18

Source: Analysis from SUSENAS 2022

RESULTS AND DISCUSSION

The results of the logistic regression analysis provide compelling evidence of the multifaceted and unequal nature of digital access among Indonesian households. Drawing from a nationally representative dataset, the findings highlight how geographic location, educational attainment, employment status, income, and demographic characteristics interact in complex ways to shape a household's likelihood of accessing the internet, as presented in Table 3.

Table 3. Logit Regression Estimation Results

Variables	Coefficient	Marginal Effect
Rural-Urban Residency *(Base: Rural)*	-0.5274***	-0.1394***
	(0.0203)	(0.0013)
Household-head Education	0.2162***	0.0287***
	(0.0017)	(0.0001)
Rural*Education	-0.0471***	-
	(0.0021)	
Household Income	-0.1899***	-0.0292***
	(0.0134)	(0.0020)
Employment Status *(Base: Informal)*	-0.6381***	-0.0981***
	(0.0091)	(0.0013)
Household Size	-0.0612***	-0.0094***
	(0.0037)	(0.0005)
Household-head Age	-0.0812***	-0.0124***
	(0.0004)	(0.00004)
Constant	5.9924***	
	(0.1942)	
Observations	339,584	
LR chi2	151148.33	
Prob > chi2	0.0000	

Source: Analysis from SUSENAS 2022

Standard errors (in parathenses)

*** p<0,01, ** p<0,05, * p<0,1

The logit regression results offer robust empirical evidence of significant disparities in household access to digital technology in Indonesia, with all included variables showing statistically significant effects at the 1% level. The most salient finding relates to the strong negative association between rural residence and the probability of having internet access. The marginal effect of –0.1394 indicates that, all else equal, rural households are approximately 14 percentage points less likely to access the internet compared to their urban counterparts. This reinforces the foundational argument of the digital divide theory, which emphasizes spatial inequalities in digital infrastructure, service provision, and institutional support (Haffner, 2017). The rural-urban gap remains a persistent structural barrier, despite national efforts to expand internet connectivity in remote areas (Anil et al., 2024).

Educational attainment of the household head emerges as one of the strongest positive predictors of digital access. Each additional year of schooling is associated with a 2.87 percentage point increase in the probability of internet access, underscoring the role of human capital in enabling households to perceive, adopt, and utilize digital technologies (Bontsa et al., 2023; Rahman et al., 2025). However, the inclusion of an interaction term between rural residence and education reveals a negative moderating effect (–0.0471), suggesting that the positive impact of education on digital access is significantly weaker in rural settings. This finding indicates a compounded disadvantage that even educated individuals in rural areas may face infrastructural or market barriers that limit their ability to leverage digital tools (Ferrari et al., 2022). In other words, education alone is insufficient to bridge the digital divide when geographic context is not conducive.

Contrary to expectations, household income (proxied by per capita expenditure) is negatively associated with digital access, both in coefficient (–0.1899) and marginal effect (–0.0292). This counterintuitive result may stem from data structure or non-linear effects, particularly if high-income households are concentrated in areas with already saturated access, while middle-income households are the ones actively adopting digital services. Alternatively, income may be capturing trade-offs in budget allocation across non-digital essentials, especially in larger or multigenerational households.

Employment status also plays a critical role. Households headed by individuals in formal employment are significantly more likely to have internet access, as indicated by a large and

negative coefficient (–0.6381) for informal workers. This supports prior findings that formal sector workers typically have greater digital exposure through the workplace, more stable incomes, and access to institutional support for adopting digital tools (Colbert et al., 2016). Informality, on the other hand, is frequently linked to precarious economic conditions that limit discretionary spending on non-essential services such as the internet.

Household size and age of the household head also exhibit negative relationships with digital access. Larger households may face intra-household competition for device use or may prioritize collective needs over digital connectivity. This aligns with findings from China, where household crowding and generational hierarchies influence digital behavior (Bai et al., 2023). Likewise, older household heads may be less inclined to adopt new technologies due to digital illiteracy, perceived lack of relevance, or resistance to change, consistent with theories of generational digital exclusion (Berkowsky et al., 2017; Neves & Mead, 2021).

Overall, the results affirm that digital access is not merely a function of individual attributes such as income or education, but rather the outcome of a complex interaction between social structure, spatial dynamics, and institutional access. The diminished impact of education in rural settings and the penalizing effect of informal employment suggest that policies aimed at closing the digital divide must be both multi-dimensional and context-specific. Interventions that focus solely on infrastructure or education will fall short unless accompanied by institutional reforms that address labor market segmentation, spatial inequality, and broader issues of digital inclusion.

Table 4. Logit Regression Estimation Classified by Gender

Variables	Male		Female	
	Coefficient	**Marginal Effect**	**Coefficient**	**Marginal Effect**
Rural-Urban Residency *(Base: Rural)*	-0.5117*** (0.0223)	-0.1414*** (0.0015)	-0.7722*** (0.0518)	-0.1345*** (0.0030)
Household-head Education	0.2106*** (0.0018)	0.0286*** (0.0001)	0.2281*** (0.0040)	0.0258*** (0.0002)
Rural*Education	-0.0468*** (0.0023)	-	-0.0404*** (0.0057)	-
Household Income	-0.1713*** (0.0148)	-0.0271*** (0.0023)	-0.0418 (0.0350)	-0.0051*** (0.0043)
Employment Status *(Base: Informal)*	-0.6973*** (0.0098)	-0.1106*** (0.0015)	-0.4008*** (0.0260)	-0.0495*** (0.0031)
Household Size	-0.0764*** (0.0040)	-0.0121*** (0.0006)	-0.0561*** (0.0120)	-0.0069*** (0.0014)
Household-head Age	-0.0780*** (0.0004)	-0.0123*** (0.00005)	-0.0897*** (0.0011)	-0.0111*** (0.0001)
Constant	5.7650*** (0.2131)		3.9385*** (0.5156)	

Observations	288,218	51,366
LR chi2	118828.51	25708.94
Prob > chi2	0.0000	0.0000

Source: Analysis from SUSENAS 2022

Standard errors (in parathenses)

*** p<0,01, ** p<0,05, * p<0,1

Disaggregating the regression analysis by gender of the household head in Table 4 reveals nuanced differences in how socio-economic factors influence digital access across household types. Although rural residence significantly decreases the likelihood of internet access for both male- and female-headed households, the magnitude of the effect is notably stronger among female-headed households. Specifically, the marginal effect for rural residency is –14.1 percentage points for male-headed households, compared to –13.5 percentage points for female-headed households, though the coefficient is much larger in the female model. This suggests that spatial disadvantage intersects more severely with gender-based vulnerabilities, reinforcing the argument that rural women are disproportionately excluded from digital infrastructure due to systemic barriers in mobility, financial autonomy, and access to public services (Gupta & Kiran, 2025; Manzar et al., 2016).

Education remains a significant predictor of internet access across both groups, with each additional year of schooling increasing the likelihood of access. Interestingly, the marginal effect of education is slightly higher among male-headed households (2.86%) than among female-headed households (2.58%). While this may seem minor, the difference points to how education, though universally beneficial, may not fully offset the structural constraints female heads of household face, especially in contexts of poverty, caregiving burdens, or limited exposure to digital environments (Faith, 2018). The interaction term between rural and education is negative and significant for both groups, but less pronounced for women (–0.0404 vs. –0.0468), implying that education is more strongly penalized by geographic location among men, possibly because male heads in rural areas are more likely to work in labor-intensive sectors that do not facilitate digital engagement.

The role of employment status shows a marked gendered divide. For male-headed households, being employed in the formal sector is associated with a much stronger positive effect on internet access (marginal effect: –11.1%) compared to female-headed households (–4.95%). This disparity reflects the broader labor market segmentation in Indonesia, where men

are more concentrated in formal employment, often with greater exposure to digital tools at work (Colbert et al., 2016). Women, on the other hand, are more likely to be engaged in informal or care-based labor, which tends to be disconnected from digital infrastructure and less economically secure, further limiting household investment in internet services (Sarker, 2021).

Other control variables also exhibit gendered effects. Larger household sizes reduce the likelihood of internet access for both groups, but the negative effect is stronger for male-headed households, possibly due to greater intra-household competition for digital resources. Meanwhile, the age of the household head has a more pronounced negative effect in female-headed households, suggesting that older women may face sharper technological barriers, including lower digital literacy and confidence in navigating online platforms, although they had positive attitude towards technology (Cajamarca & Herskovic, 2022). Notably, household income is significant only among male-headed households. The lack of statistical significance for income in the female model suggests that economic capacity alone is not sufficient to enable digital inclusion for women, social and institutional factors likely play a larger role in shaping their digital access.

Taken together, these findings highlight the intersectional nature of digital exclusion, where gender and geography interact with education, employment, and household dynamics to produce differentiated outcomes. This supports existing literature on the feminization of digital disadvantage, particularly in the Global South (Pei et al., 2024). The findings underscore the need for gender-responsive digital policy frameworks that go beyond infrastructure expansion to include targeted investments in digital literacy, affordable internet, and support for women in informal and rural economies.

CONCLUSION

This study provides empirical evidence on the complex nature of digital access inequality among Indonesian households. The analysis reveals that rural households remain significantly disadvantaged in accessing internet services, even when accounting for education, income, employment, and demographic characteristics. Education emerges as a critical enabler of digital access, yet its benefits are not uniformly distributed. The positive effect of education is systematically weaker in rural areas, suggesting that structural limitations in infrastructure and opportunity environments constrain its potential. Furthermore, the burden of exclusion is

disproportionately borne by households headed by women, particularly in rural areas where geographic isolation intersects with gender-based barriers to reinforce disadvantage.

Employment in the informal sector and increasing household size further reduce the likelihood of digital access, indicating that economic precarity and resource competition within households play important roles in shaping digital inclusion. The findings also reveal that the impact of household income is less consistent, particularly among female-headed households, where social norms and digital literacy may function as stronger determinants than financial capability alone. Taken together, these patterns demonstrate that infrastructure-only policies are insufficient. Thus, expanding digital connectivity must be accompanied by interventions that address socio-economic disadvantages and gender-specific barriers that constrain household digital access.

The findings of this study imply that policies aimed at bridging the digital divide must move beyond generic interventions. Instead, they should be tailored to the intersecting vulnerabilities of location, gender, education, and employment. Investments in rural digital infrastructure must be coupled with gender-sensitive digital literacy programs, especially for women in informal or unpaid labor. Strengthening institutional support for female-headed households and creating inclusive digital ecosystems in rural areas are essential steps toward achieving equitable digital transformation in Indonesia.

REFERENCES

Acilar, A., & Sæbø, Ø. (2023). Towards understanding the gender digital divide: A systematic literature review. *Global Knowledge, Memory and Communication, 72*(3), 233–249. https://doi.org/10.1108/GKMC-09-2021-0147

Agwu, M. E. (2020). Can technology bridge the gap between rural development and financial inclusions? *Technology Analysis and Strategic Management*, 1–11. https://doi.org/10.1080/09537325.2020.1795111

Anil, K., Jeevan, N., Nandini, H., & Chandana, L. (2024). Bridging the gap: Understanding and addressing rural–urban disparity. *Vigyan Varta: An International E-Magazine for Science Enthusiasts, 5*(9), 144–146.

Asosiasi Penyelenggara Jasa Internet Indonesia (APJII). (2024). *APJII jumlah pengguna internet Indonesia tembus 221 juta orang*. Retrieved April 1, 2025, from https://inet.detik.com/cyberlife/d-7169749/apjii-jumlah-pengguna-internet-indonesia-tembus-221-juta-orang

Bai, Q., Chen, H., Zhou, J., Li, G., Zang, D., Sow, Y., & Shen, Q. (2023). Digital literacy and farmers' entrepreneurial behavior: Empirical analysis based on CHFS2019 micro data. *PLoS ONE, 18*(7), Article e0288245. https://doi.org/10.1371/journal.pone.0288245

Berkowsky, R. W., Sharit, J., & Czaja, S. J. (2017). Factors predicting decisions about technology adoption among older adults. *Innovation in Aging, 2*(1), 1–12. https://doi.org/10.1093/geroni/igy002

Bontsa, N. V., Mushunje, A., & Ngarava, S. (2023). Factors influencing the perceptions of smallholder farmers towards adoption of digital technologies in Eastern Cape Province, South Africa. *Agriculture, 13*(8), Article 1471. https://doi.org/10.3390/agriculture13081471

Briglauer, W., Krämer, J., & Palan, N. (2024). Socioeconomic benefits of high-speed broadband availability and service adoption: A survey. *Telecommunications Policy, 48*(7), Article 102808. https://doi.org/10.1016/j.telpol.2024.102808

Cajamarca, G., & Herskovic, V. (2022). Understanding experiences and expectations from active, independent older women in Chile towards technologies to manage their health. *International Journal of Human–Computer Studies, 166*, Article 102867. https://doi.org/10.1016/j.ijhcs.2022.102867

Colbert, A., Yee, N., & George, G. (2016). The digital workforce and the workplace of the future. In *Institutional Knowledge at Singapore Management University* (pp. 731–739).

Elena-Bucea, A., Cruz-Jesus, F., Oliveira, T., & Coelho, P. S. (2021). Assessing the role of age, education, gender and income on the digital divide: Evidence for the European Union. *Information Systems Frontiers, 23*(4), 1007–1021. https://doi.org/10.1007/s10796-020-10012-9

Faith, B. (2018). Maintenance affordances and structural inequalities: Mobile phone use by low-income women in the United Kingdom. *Information Technologies & International Development, 14*, 66–80.

Ferrari, A., Bacco, M., Gaber, K., Jedlitschka, A., Hess, S., Kaipainen, J., Koltsida, P., Toli, E., & Brunori, G. (2022). Drivers, barriers and impacts of digitalisation in rural areas from the viewpoint of experts. *Information and Software Technology, 145*, Article 106816. https://doi.org/10.1016/j.infsof.2021.106816

Guo, Y., Deng, Y., & Meng, Q. (2023). How does the citizen's education level affect their internet rights protection willingness? *Digital Government: Research and Practice, 4*(4). https://doi.org/10.1145/3624573

Gupta, M., & Kiran, R. (2025). Digital exclusion of women: A systematic review. *Global Knowledge, Memory and Communication, 74*(3), 938–957. https://doi.org/10.1108/GKMC-12-2022-0301

Haffner, J. (2017). Critical infrastructures, critical geographies: Towards a spatial theory of the digital divide. In *Theorizing Digital Divides* (pp. 103–116). Routledge.

Hassan, M. M., & Mirza, T. (2021). The digital literacy in teachers of the schools of Rajouri (J&K)-India: Teachers perspective. *International Journal of Education and Management Engineering, 11*(1), 28–40. https://doi.org/10.5815/ijeme.2021.01.04

Kansiime, M. K., Mugambi, I., Rware, H., Alokit, C., Aliamo, C., Zhang, F., Latzko, J., Yang, P., Karanja, D., & Romney, D. (2022). Challenges and capacity gaps in smallholder access to digital extension and advisory services in Kenya and Uganda. *Frontiers of Agricultural Science and Engineering, 9*(4), 642–654. https://doi.org/10.15302/J-FASE-2021423

Kerkhoff, S. N., & Makubuya, T. (2022). Professional development on digital literacy and transformative teaching in a low-income country: A case study of rural Kenya. *Reading Research Quarterly, 57*(1), 287–305. https://doi.org/10.1002/rrq.392

Lynn, T., Rosati, P., Conway, E., Curran, D., Fox, G., & O'Gorman, C. (2022). *Digital towns: Accelerating and measuring the digital transformation of rural societies and economies*. Springer. https://doi.org/10.1007/9783030912475

Manzar, O., Kumar, R., Mukherjee, E., & Aggarwal, R. (2016). Exclusion from digital infrastructure and access. In *India Exclusion Report 2016* (pp. 66–95). Centre for Equity Studies.

McGuire, R., Longo, A., & Sherry, E. (2022). Tackling poverty and social isolation using a smart rural development initiative. *Journal of Rural Studies, 89*, 161–170. https://doi.org/10.1016/j.jrurstud.2021.11.010

Neves, B. B., & Mead, G. (2021). Digital technology and older people: Towards a sociological approach to technology adoption in later life. *Sociology, 55*(5), 888–905. https://doi.org/10.1177/0038038520975587

Pei, X., Chen, Z. T., & Zhang, L. (2024). Comprehending ICT for gender empowerment in an aging context: Digitalization of marginalized female elderly in the Global South during COVID-19. *Information Technology for Development, 30*(2), 291–307. https://doi.org/10.1080/02681102.2023.2300669

Pérez-Amaral, T., Valarezo, A., López, R., & Garín-Muñoz, T. (2021). Digital divides across consumers of internet services in Spain using panel data 2007–2019: Narrowing or not?

Telecommunications Policy, 45(2), Article 102093. https://doi.org/10.1016/j.telpol.2020.102093

Rahman, M. I., Alam, J., Khanom, K., & Bin Emdad, F. (2025). Social determinants influencing internet-based service adoption among female family caregivers in Bangladesh: A sociodemographic and technological analysis. *Health Science Reports, 8*(e70665). https://doi.org/10.1002/hsr2.70665

Raihan, M. M. H., Subroto, S., Chowdhury, N., Koch, K., Ruttan, E., & Turin, T. C. (2024). Dimensions and barriers for digital (in)equity and digital divide: A systematic integrative review. *Digital Transformation and Society, 3*(1). https://doi.org/10.1108/DTS-04-2024-0054

Sarker, M. R. (2021). Labor market and unpaid works implications of COVID-19 for Bangladeshi women. *Gender, Work & Organization, 28*(S2), 597–604. https://doi.org/10.1111/gwao.12587

Schneider, F., Morkunas, M., & Quendler, E. (2023). An estimation of the informal economy in the agricultural sector in the EU-15 from 1996 to 2019. *Agribusiness, 39*(2), 406–447. https://doi.org/10.1002/agr.21774

Sindakis, S., & Showkat, G. (2024). The digital revolution in India: Bridging the gap in rural technology adoption. *Journal of Innovation and Entrepreneurship, 13*(1). https://doi.org/10.1186/s13731-024-00380-w

Tryphone, K., Joseph, C., & Ndanshau, M. O. (2023). Determinants of digital transformation in Sub-Saharan Africa: Some fiscal policy implications. *African Journal of Economic Review, 11*(4), 34–48. https://doi.org/ 10.22004/ag.econ.339655

van Deursen, A. J. A. M., van der Zeeuw, A., de Boer, P., Jansen, G., & van Rompay, T. (2021). Digital inequalities in the Internet of Things: Differences in attitudes, material access, skills, and usage. *Information, Communication & Society, 24*(2), 258–276. https://doi.org/10.1080/1369118X.2019.1646777

van Dijk, J. (2017). Afterword: The state of digital divide theory. In *Theorizing Digital Divides* (pp. 199–206). Routledge. https://doi.org/10.4324/9781315455334

Wilson, K. R., Wallin, J. S., & Reiser, C. (2003). Social Stratification and the Digital Divide. *Social Science Computer Review*, *21*(2), 133 143. https://doi.org/10.1177/0894439303021002001