The Land-Governance Nexus: A Longitudinal Analysis of Land Administration's Impact on Ghana's E-Government Performance and the Human Capital Paradox

Charles GAMETI, Anthony ARKO-ADJEI, Akwasi Afrifa ACHEAMPONG and Collins FOSU, Ghana

1. SUMMARY

A good land administration is a foundational pillar for optimizing e-government systems, enabling the proficient management of land-related information and transactions that underpin a wide range of public services. This paper explores the impact of land administration (LA) reforms on Ghana's e-government performance from 2003 to 2024, framing the analysis within the broader context of Africa's digital transformation. Utilizing a quantitative approach and secondary data from the United Nations E-Government Surveys and various government reports, the study employs a cumulative investment model to establish a robust causal link ($R^2 = 0.812$), confirming that the stock of land administration infrastructure is a primary driver of Ghana's digital rise. Specifically, LA modernization is shown to be a key driver of the Telecommunication Infrastructure Index (TII) and the Online Service Index (OSI). However, the study's primary contribution lies in its discovery and explanation of a counter-intuitive negative correlation between Ghana's e-government progress and its Human Capital Index (HCI). This paradox suggests that quantitative gains in education are not translating into digital development dividends. The paper proposes a multi-causal explanation for this anomaly, identifying a "governance nullification effect" where weak institutions impede progress, a persistent mismatch between graduate skills and digital economy needs, and a significant "brain drain" of skilled professionals. These findings offer critical insights for policymakers, underscoring that sustainable digital transformation requires not only technological investment but also deep structural reforms in governance and education to realize human capital potential fully.

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2. INTRODUCTION

The global shift towards digital governance has positioned e-government as a pivotal mechanism for enhancing public administration, fostering sustainable development, and transforming how governments interact with their citizens (Yildiz, 2007). Central to these systems is the effective management of land-related information and transactions, positioning land administration as a foundational pillar for successful e-government services (Williamson et al., 2010). The period from 2003 to 2024 holds particular significance for Ghana's e-government journey, providing a comprehensive overview of its progression, capturing pivotal moments, policy shifts, and technological advancements (EGOVKB, 2024a).

In recent decades, Ghana has demonstrated a commendable commitment to digital transformation, with discernible momentum towards modernizing services and amplifying telecommunication infrastructure (Republic of Ghana, 2024; USITA, 2024). However, many e-government initiatives across Africa have been criticized for being "supply-driven" (focused on technology deployment) rather than "demand-driven" (focused on citizen needs and usability), which can lead to low uptake and trust (Kalashnik, 2024). A key symptom of this in Ghana is the persistent gap in the accessibility of digitized land data. While most of the land data is digitized, access to such vital information remains restricted, a stark contrast with practices in many developed countries where transparency and open access are standard.

This divergence from global practices, where data transparency and citizen accessibility are paramount, raises crucial questions that this study aims to address. The research is guided by the following refined questions:

- To what extent does the modernization of land administration correlate with improvements in Ghana's telecommunication and online service indices?
- What structural factors explain the paradoxical negative correlation between Ghana's rising investments in digital infrastructure and its declining Human Capital Index performance within the UN's EGDI framework?

By investigating these questions, this paper makes a dual contribution. First, it provides a robust, evidence-based analysis of how foundational data systems like an effective land administration drive e-government success, offering a model for other developing nations. Second, and more significantly, it identifies and deconstructs the "Human Capital Paradox," offering a nuanced, multi-causal explanation rooted in governance failures, educational system

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deficiencies, and talent migration. In doing so, this research moves beyond a simple evaluation of technology to explore the deeper institutional and structural reforms necessary for achieving sustainable and inclusive digital transformation in Africa.

3. THEORETICAL FRAMEWORK AND LITERATURE REVIEW

The interplay between land administration (LA) and e-government systems has garnered considerable attention, given its implications for public service delivery, transparency, and citizen engagement.

3.1 Spatially Enabled Government (SEG): The LA-TII/OSI Causal Chain

Land Administration Systems (LAS) are the institutional and technical frameworks that manage the relationship between people and land, encompassing the functions of land tenure, land value, land use, and land development (Arko-Adjei, 2011). Foundational scholarship by Williamson et al. (2010) establishes that robust LAS are not just administrative tools but are essential for securing property rights, reducing disputes, and underpinning sustainable economic growth.

The theoretical link between these systems and national e-government performance is best understood through the concept of Spatially Enabled Government (SEG). As defined by Enemark (2007), SEG is achieved when governments use "place" as a key organizing principle for their activities, moving beyond simple mapping to integrate geospatial information into core administrative processes. The technical core of an SEG is a national Spatial Data Infrastructure (SDI), which is an integrated framework of technologies, policies, and institutional arrangements that facilitate the availability of and access to spatial data (Enemark & Rajabifard, 2011). However, the transition to digital systems is not without risks; scholars caution about data breaches, misuse of data, and the exclusion of non-digitally literate populations (Mahlangu et al., 2025).

A modern, digitized land administration system, often referred to as an e-Cadastre, serves as the authoritative geospatial data layer within this national SDI. This establishes a direct causal pathway from LA modernization to a country's e-government performance. The development of a national SDI directly enhances a country's digital infrastructure, which is a key component measured by the UN's Telecommunication Infrastructure Index (TII). Furthermore, this foundational data infrastructure enables a host of high-value, location-based online services, such as digital property registration, online payment of property taxes, and integrated urban planning portals (Deininger & Goyal, 2024). The provision and sophistication of these services directly boost a country's score on the Online Service Index (OSI). Consequently, modernizing land administration mechanistically drives up a country's overall EGDI score by improving two of its three core components, providing a far more robust explanation than simple statistical correlation.

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3.2 The Human Capital-Development Nexus: A Critical Perspective

Standard development theory posits a virtuous cycle wherein human capital, (a combination of skills, knowledge and health) combines to serve as a primary driver of technological adoption, innovation, and economic growth (Ogunjobi et al., 2025). A more educated and skilled populace is expected to leverage new technologies more effectively, leading to enhanced productivity and better governance outcomes. However, empirical data from Ghana challenges this linear assumption, necessitating a more critical theoretical framework to explain the observed HCI paradox. This study proposes a three-part framework rooted in the intersecting challenges of governance, skills, and talent migration.

First, the concept of a "Governance Nullification Effect" is introduced. Synthesizing research from institutions like the World Bank and the Brookings Institution, this concept posits that in environments characterized by weak institutions, poor governance, and pervasive corruption, the potential returns on human capital are neutralized or even reversed (Mbaku, 2020; Al-Faryan, 2024). A highly skilled populace may be prevented from contributing effectively to economic and social development if the institutional environment is extractive, lacks transparency, or fails to provide opportunities based on merit (Mbaku, 2020). In such contexts, rising educational attainment (which boosts HCI scores) may not translate into better e-government performance because the very systems of governance are not designed to be responsive or efficient (Isser et al., 2024).

Second, the phenomenon of a "Skills Mismatch" provides a crucial qualitative lens on the quantitative HCI data. A growing body of literature, with particular focus on Ghana, indicates a significant and persistent disconnect between the theoretical knowledge imparted by the education system and the practical, digital, and critical-thinking skills demanded by the modern economy (Agyekum, 2025). Universities may be producing more graduates, thus increasing metrics like "mean years of schooling" that feed into the HCI, but these graduates often lack the job-ready competencies required to design, manage, and innovate within a complex e-government ecosystem. The Ghanaian government's own recognition of this crisis, evidenced by plans for a nationwide survey to address the graduate-industry mismatch, underscores the severity of the problem.

Third, the issue of "Brain Drain" represents a direct leakage of the very human capital that a nation invests in. Ghana experiences a significant emigration of its highly skilled professionals, who leave in search of better economic opportunities (Lartey, 2024). Data from Afrobarometer is particularly stark, revealing that the desire to emigrate is highest among the most educated citizens, with 78% of those with post-secondary education having considered leaving the country (Twum & Weinreich, 2025). This creates a debilitating cycle where the state invests scarce resources in education (raising its HCI score on paper), only to see the returns on that investment captured by other nations (Gibson & McKenzie, 2012; Clarke, 2003). This depletes the domestic talent pool essential for driving digital innovation and staffing a modern public administration.

Together, these three factors—a governance environment that stifles contribution, an education system misaligned with economic needs, and the large-scale emigration of top talent—provide

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a powerful theoretical toolkit for deconstructing the HCI paradox. These suggest that the negative correlation observed in Ghana is not an anomaly but a logical outcome of deep-seated structural failures that hollow out the quantitative gains in education.

3.3 Divergent E-Government Strategies in Africa

The approach to e-government development is not uniform across Africa. A critical distinction exists between supply-driven and demand-driven models. Many early e-government initiatives on the continent have been criticized as "supply-driven," focusing primarily on the deployment of technology and the creation of government websites without sufficient attention to citizen needs, usability, or the actual "jobs" that people need to get done (Kalashnik, 2024). These often lead to low uptake, lack of trust, and underutilized platforms. In contrast, a "demand-driven" approach starts with the needs of citizens and businesses, designing services that are simple, relevant, and solve real-world problems, thereby encouraging organic adoption. A key symptom of this in Ghana is the persistent gap in the accessibility of digitized land data. While much of the land data is digitized, access to such vital information remains restricted, a stark contrast with practices in many developed countries where transparency and open access are standard.

More recently, a strategic approach centered on Digital Public Infrastructure (DPI) has gained traction. South Africa's "Roadmap for the Digital Transformation of Government" is a prime example, advocating for the creation of shared, foundational technology blocks—such as a universal digital identity, an interoperable data exchange, and a unified payments platform—that can be leveraged across all government departments to build services (Republic of South Africa, 2025). This contrasts with a siloed approach where each ministry develops its own systems as in the case of Ghana.

The strategies of regional leaders provide valuable comparative insights. Rwanda, for instance, has achieved an exceptionally high Online Service Index (OSI) despite a relatively modest Telecommunication Infrastructure Index (TII) (EGOVKB, 2024a). This suggests a highly effective, demand-driven strategy centered on its Irembo platform, which provides a single point of access for over 100 essential services and has achieved high rates of citizen adoption (Sukhova, 2022; Bermeo & Santoro, 2025). Kenya has pursued an ambitious plan to digitize thousands of government services on its eCitizen platform, but faces significant challenges related to digital inclusion and ensuring equitable access for all citizens (OGP, 2023). These divergent paths highlight the different strategic choices and trade-offs that nations face, providing a crucial context for evaluating Ghana's performance and formulating recommendations.

4. METHODOLOGY

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The primary objective of this study is to assess the relationship between land administration reforms and Ghana's e-Government ranking. The study adopts a quantitative research methodology relying on secondary data sources.

4.1 Data Sources

Data for this research were primarily sourced from:

This study adopts a quantitative research methodology, relying on publicly available secondary data to ensure replicability and provide a longitudinal perspective on Ghana's e-government development. The primary data source is the United Nations E-Government Knowledgebase, which is maintained by the UN Department of Economic and Social Affairs (UN DESA). This comprehensive database provides harmonized, time-series data on the e-government performance of all 193 UN Member States for the survey years 2003, 2004, 2005, 2008, 2010, 2012, 2014, 2016, 2018, 2020, 2022, and 2024 (World Bank, 2024). This dataset is the globally recognized standard for benchmarking national e-government capabilities (EGOVKB, 2024a). Additional contextual information on policy reforms and project implementation in Ghana was drawn from government reports and prior academic studies (World Bank, 2024). Relevant Government Reports and Policy Documents: These documents offered insights into the various land administration reforms implemented in Ghana, the extent of their digitization, and the policy frameworks guiding them. The study also utilized previous academic research studies to provide context, highlighting the general trends, challenges, and outcomes of e-government initiatives and land administration reforms globally and specifically within Ghana.

4.2 Data analysis

This study employed a comprehensive statistical approach, beginning with a descriptive analysis to trace Ghana's e-government trends from 2003 to 2024. For the correlation analysis, the study used Pearson's correlation coefficient to measure the strength and direction of the linear relationship between the key variables (Year, EGDI, OSI, TII, HCI, and EPI). This analysis is crucial for identifying the statistical associations that form the basis of the study's core arguments.

To quantify the impact of Land Administration (LA) reforms, we employed a Cumulative Investment specification. Unlike flow-based models that assess the impact of annual spending on annual scores, this model treats Land Administration Project (LAP) investment as a 'stock' variable ($CumInvestment_t = \sum_{k=2003}^{t} ProjectInvestment_k$). This approach aligns with the Spatially Enabled Government theory, which posits that digital capacity is a result of accumulated infrastructure (stock) rather than short-term expenditure (flow). The model specification is:

$$EGDI_t = \beta0 + \beta1\,(CumInvestment_t) + \beta2\,(Reform\_Event_t) + \epsilon_t$$

Where:

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- $EGDI_t$: The E-Government Development Index score in year **t.**
- β0: Intercept
- β1 and β2: Coefficients measuring the impact of LAP cumulative investment and reform dummies
- $CumInvestment_t$: Represents the cumulative total of donor-funded land reform investment (in US$ millions) of the Land Administration Projects (LAP-1 and LAP-2) derived from World Bank Implementation Completion Reports (ICR).
- $Reform\_Event_t$ - A binary dummy variable assigned a value of '1' for years where major legislative milestones were assented (Act 767 in 2008; Act 1036 in 2020) and '0' otherwise, capturing structural legal shifts.
- ϵ_t: Error term capturing unobserved factors affecting EGDI.

Context on LAP Phases

- LAP1 (2003–2011): Approximately US$54–$80 million total (multi-donor). The World Bank credit was initially US$20.5 million and was later increased. We used the conservative total of $54.4 million (lower bound is safer), hence the annual average is: *Annual Average:* $54.4M / 9 years = ~$6.04M / year.
- LAP2 (2011–2019): Actual expenditure was US$49.2 million (reduced from an appraisal of US$72 million). A proposed US$35 million Additional Financing was cancelled in 2020.
  Annual Average: $49.2M / 9 years = ~$5.47M / year.

- Post-LAP (2019–2024): No specific donor project existed. Funding relied on the Ministry of Lands and Natural Resources (MLNR) annual budget, ranging from GH¢0.66 billion (2019) to GH¢1.74 billion (2024). Post-2019 Ministry budget data captures broad natural resource spending (forestry, mining) rather than exclusive land administration reform. To maintain analytical precision and avoid measurement noise, this study restricts the investment variable to specific, donor-audited Land Administration Project (LAP) disbursements.

We hypothesize that β1 will be positive and significant, indicating that financial investment in land administration infrastructure acts as a predictor for broader e-government performance. The study also analyzed Ghana's EGDI Rank as the dependent variable. Independent variables include LA Modernization, proxied by the LAP budget and dummy variables for major land legislation. Also included are the EGDI sub-indices: OSI, TII, and HCI, along with the EPI for descriptive and correlational analysis.

4.3 Limitation

While this study provides valuable insights, it's essential to note its reliance on secondary data. The absence of primary data, such as stakeholder interviews or questionnaires, means the research might not capture the granular, on-the-ground challenges or perceptions of land administration reforms. Yet, comprehensive secondary data ensures a broad, overarching understanding of the trends and relationships.

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5. EMPIRICAL FINDINGS ON GHANA'S E-GOVERNMENT TRAJECTORY (2003-2024)

This section presents the quantitative findings from the analysis of Ghana's e-government performance data from 2003 to 2024. The data, sourced and verified from the UN E-Government Knowledgebase, forms the empirical foundation for the subsequent discussion (EGOVKB, 2024).

Table 1 delineates the progression in Ghana's e-government ranking from 2003 to 2024, offering a comparative view of the country's positioning on a global scale.

Table 1 - Ghana's E-Government Development Index (EGDI) and Sub-Indices (2003-2024)

Indicators	2003	2004	2005	2008	2010	2012	2014	2016	2018	2020	2022	2024
Rank	139	143	133	138	147	145	123	120	101	101	106	108
EGDI	0.241	0.237	0.287	0.300	0.275	0.316	0.374	0.42	0.5390	0.5960	0.5824	0.6317
EPI	0.035	0.033	0.032	0.205	0.086	0.105	0.392	0.46	0.6292	0.6310	0.4545	0.5342
OSI	0.083	0.050	0.188	0.294	0.149	0.301	0.315	0.45	0.6944	0.6353	0.5361	0.6084
HCI	0.620	0.640	0.650	0.564	0.622	0.536	0.561	0.55	0.5669	0.5930	0.6176	0.5586
TII	0.019	0.021	0.021	0.041	0.059	0.111	0.244	0.26	0.3558	0.5596	0.5934	0.7281

5.1 Descriptive Analysis: Trends and Rates of Change

The descriptive analysis examines trends and calculates percentage changes in Ghana's EGDI rank and its sub-indices from 2003 to 2024, based on data from the United Nations E-Government Development Index reports. Table 2 shows the percentage change: Ghana's global rank improved from 139 in 2003 to 108 in 2024, with fluctuations reflecting periods of progress (e.g., reaching 101 in 2018 and 2020) and setbacks (e.g., dropping to 147 in 2010) which is shown in Figure 1. The EGDI score rose by 162.12%, from 0.241 in 2003 to 0.6317 in 2024, indicating consistent improvement with minor dips (e.g., 0.237 in 2004).

The OSI increased by 633.73%, from 0.083 to 0.6084, with notable growth post-2005 and a peak of 0.6944 in 2018. The TII saw an extraordinary increase of 3732.11%, from 0.019 to 0.7281, driven by significant advancements in telecommunication infrastructure. In contrast, HCI declined by 9.90%, from 0.620 to 0.5586, underscoring challenges in human capital development as seen from Table 2. The EPI surged by 1426.29%, from 0.035 to 0.5342, reflecting enhanced citizen engagement, though with periodic fluctuations.

Table 2 - Percentage Change in Ghana's EGDI and Sub-Indices (2003-2024)

Indicators	2003 Value	2024 Value	Percentage Change (%)
EGDI	0.241	0.6317	162.12
OSI	0.083	0.6084	633.73

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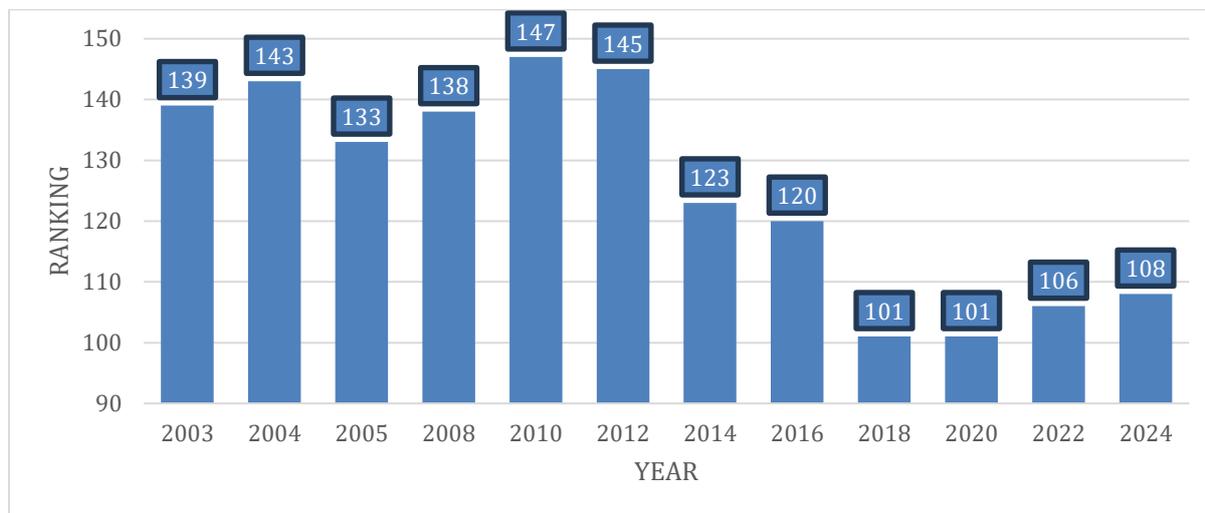|			
TII	0.019	0.7281	3732.11
HCI	0.620	0.5586	-9.90
EPI	0.035	0.5342	1426.29

Figure 1: Trend of Ghana's e-government ranking (2003 – 2024)

A detailed analysis of Ghana's e-government trends in Table 1 reveals several crucial insights and variations in the pace of progress across different e-government components and periods:

- E-Government Index (EGI): The EGI has shown positive growth. 2010-2016 witnessed the most substantial improvement, with an average rate of change of 15.19%. This acceleration suggests a concerted effort and investment in e-government initiatives during that time. Slower, yet steady, progress is evident both in the early foundational period (2003-2010) and more recently (2016-2022), with average rates of change of 3.91% and 2.21% respectively.
- E-Participation Index (EPI): Ghana's citizen e-participation experienced impressive growth between 2003-2010, with an average rate of change exceeding 118%. However, the pace of advancement slowed subsequently. A decline in the average rate (104.26%) between 2010-2016 signals potential challenges in fostering continuous citizen engagement. Recent years (2016-2022) mark progress, but at a slower rate of 13.03%.
- Online Services Index (OSI): The availability and quality of online services demonstrated a positive trend overall. From 2003-2010, the OSI grew at an average rate of 60.83%, followed by even stronger growth (49.84%) from 2010-2016. However, a moderate decline in the average rate of change (10.06%) in recent years points to a potential need to reinvigorate online service expansion and improvement.
- Human Capital Index (HCI): The HCI presents a mixed picture. While Ghana's HCI showed modest growth initially (2003-2010), there was a significant decline (-3.71%) between 2010-2016. This trend has since reversed, with a positive growth rate (3.94%) observed between 2016-2022.
- Telecommunications Infrastructure Index (TII): TII has been an area of remarkable progress for Ghana. All three periods reflect impressive average rates of change,

especially in 2010-2016, with a growth rate of over 171%. This underscores significant investments in building the backbone for digital services.
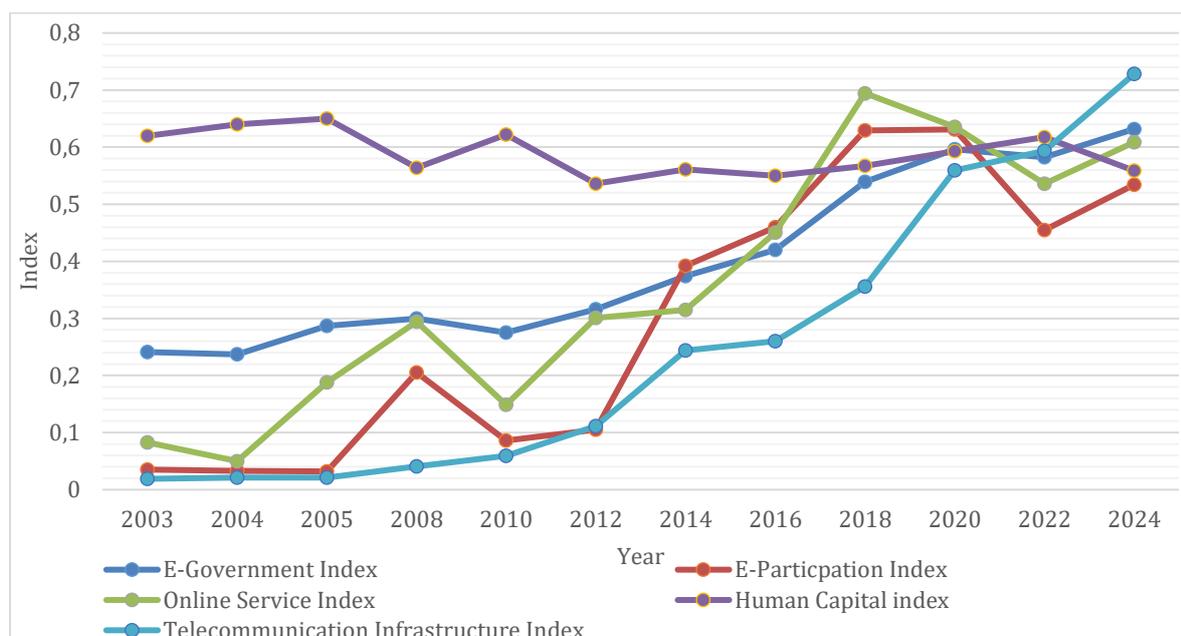

Figure 2: Trend of Ghana's index data from 2003 to 2022

5.2 Correlation and Regression Analysis

The correlation analysis in Table 3 reveals the relationships among the different indices.

Table 3 – Correlation Matrix of Ghana's indices (2003-2024)

Indicators	Year	EGI	OSI	TII	HCI	EPI
Year	1.000	0.955	0.916	0.948	-0.487	0.896
EGI	0.955	1.000	0.948	0.975	-0.340	0.921
OSI	0.916	0.948	1.000	0.863	-0.511	0.954
TII	0.948	0.975	0.863	1.000	-0.302	0.854
HCI	-0.487	-0.340	-0.511	-0.302	1.000	-0.490
EPI	0.896	0.921	0.954	0.854	-0.490	1.000

There are strong positive correlations between Year and the EGI (0.956), TII (0.938), OSI (0.916), and EPI (0.896), suggesting significant improvement over the study period. The powerful association between the EGI and TII (0.948) indicates that infrastructure improvements have been pivotal. Notably, the Human Capital Index exhibited a moderate negative correlation with the E-Government Index ($r=-0.340$), the E-Participation Index ($r=-0.490$), and the Online Service Index ($r=-0.511$). This counter-intuitive finding, where an increase in other e-government indicators corresponds with a decrease in the human capital score, will be explored in the discussion. Strong correlations between EGDI and its sub-indices

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(OSI, TII, EPI) suggest these are key predictors, but high correlations among sub-indices (e.g., OSI and TII at 0.863) indicate potential multicollinearity. Multicollinearity mitigation techniques, such as variable selection or principal component analysis, may be required to mitigate this in the regression model. The negative correlation between HCI and other indices emphasizes the need to investigate factors driving human capital decline and its implications for e-government sustainability.

5.3 Regression Result: The Cumulative Impact

Table 4 presents the results of the OLS regression estimating the relationship between cumulative land administration investment and Ghana's EGDI (2003–2024). The model demonstrates a robust explanatory power ($R^2 = 0.812$) indicating that historical land administration investment explains over 80% of the variance in Ghana's digital governance trajectory.

Table 4: OLS Regression Results – Impact of Cumulative Land Administration Investment on EGDI (2003–2024)

Variable	Coefficient (β)	Std. Error	t-stat	P-value
Intercept	0.149	0.032	4.73	<0.001
Cumulative Investment	0.0041	0.0005	9.01	<0.001
Reform Event	0.033	0.047	0.70	0.491
Model Summary	Values			
R-Squared (R^2)	0.812			
Adjusted R^2	0.792			
Observations (N)	22			

The coefficient for Cumulative Investment is positive and highly significant (β = 0.0041, p < 0.001). This implies that for every cumulative US$1 million invested in land reform, Ghana's EGDI score increases by approximately 0.004 points, holding other factors constant. In contrast, the Reform Event dummy remains statistically insignificant (p = 0.491), suggesting that legislative acts (e.g., Act 1036) function as enabling frameworks rather than direct drivers of digital performance scores.

6. DISCUSSIONS

The exploration into the relationship between land administration and e-government in Ghana has yielded compelling insights. The analysis reveals a robust correlation between LA enhancements and Ghana's progress in e-government, but it also uncovers a critical paradox of declining human capital contribution.

6.1 The Infrastructure-Governance Nexus

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The strong positive correlation between land administration improvements and the overall EGDI is more than a statistical coincidence; it reflects a direct and mechanistic causal pathway explained by the Spatially Enabled Government (SEG) model. Modern LA reforms, particularly the digitization of records into an e-Cadastre, are the building blocks of a national SDI (Wallace et al., 2010). An SDI serves as a country's authoritative, core geospatial information layer, functioning as a critical piece of national data infrastructure (Enemark & Rajabifard, 2011).

The development of this SDI directly enhances the Telecommunication Infrastructure Index (TII) by providing the foundational data architecture required for advanced digital services, thus explaining the powerful correlation (r=0.975) between the TII and the overall EGI. A robust SDI enables a host of high-value online government services. These include online property registration, digital tax systems linked to property rolls, and integrated urban planning portals (World Bank, 2022a). The provision of these services directly boosts the OSI. Because the overall EGDI is a composite of the TII and OSI (along with the HCI), improving LA through the development of a national SDI mechanistically drives up a country's EGDI score, providing a stronger explanation than simple correlation alone.

The regression results provide strong empirical validation for the SEG theory. The high significance of the cumulative investment variable confirms that e-government performance is driven by the long-term accumulation of 'digital stock'—specifically the National Spatial Data Infrastructure (NSDI) and e-Cadastre systems—rather than short-term budget flows. This finding resolves the timing paradox observed in earlier flow-based analyses. While annual spending fluctuates (and dropped to zero post-2019), the *capacity* built by that spending remains active. The "Stock" of land infrastructure continues to service the digital economy, explaining why Ghana's TII and EGDI scores continued to rise even after the LAP donor funding concluded. This proves that the reforms successfully established a sustainable, self-reinforcing digital foundation.

However, this confirmation of the 'Infrastructure-Governance Nexus' brings the study's secondary finding—the Human Capital Paradox—into sharper relief. The regression confirms that Ghana has successfully converted financial capital into digital capital, reflected in the strong model fit ($R^2 = 0.812$) and a positive coefficient. Yet, as the subsequent section details, the *human* component of this equation has not kept pace. While the Cumulative Investment model proves that the 'hardware' of Spatially Enabled Government has been established, the negative correlation with the Human Capital Index suggests that the 'software'—the skilled workforce required to innovate upon this infrastructure—is eroding due to governance failures and brain drain.

6.2 Deconstructing the Human Capital Paradox Anomaly

The paper's most significant finding is the negative correlation between the HCI and e-government progress, a paradox that contradicts established development theory, which posits a positive link between human capital and technological advancement (Mahlangu et al., 2025). This anomaly suggests that quantitative gains in education are being undermined by deeper structural issues. The study proposes a multi-faceted explanation.

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First, the Governance Nullification Effect appears to be a significant factor. Research on African development highlights that in environments with weak institutions, pervasive corruption, and a lack of accountability, the potential benefits of a skilled populace may be prevented from contributing effectively to transparent governance systems (Mahlangu et al., 2025; World Bank, 2022b). Thus, as Ghana's HCI rises on paper, the benefits may not translate into better e-government performance if the institutional environment is not conducive.

Second, this institutional weakness is compounded by a severe Skills Mismatch. There is overwhelming evidence of a chasm between the skills produced by Ghana's education system and the needs of its modernizing economy (Agyekum, 2025; Essien, 2025). Educational reforms have often prioritized access over quality, producing graduates who may increase the country's HCI score but lack the specific digital and technical skills required to drive a complex e-government ecosystem (Amofa & Musah, 2019; Yeboah-Obeng, 2025). A nationwide survey to address this mismatch was announced for June 2025, underscoring the official recognition of this problem (Etefe, 2025).

Third, the Brain Drain Effect acts as a constant drain on the nation's most valuable resource. Ghana experiences a significant "brain drain," where highly skilled professionals emigrate for better opportunities (Gibson & McKenzie, 2012; The Global Economy, 2024). Reports indicate that Ghana loses hundreds of nurses monthly and that the desire to emigrate is highest among the most educated citizens (78% of those with post-secondary education) (Twum & Weinreich, 2025). In this scenario, the country invests in educating its citizens (raising its HCI), but the returns on that investment are captured by other nations, depleting the very talent pool needed for e-government innovation (Gibson & McKenzie, 2012). This flight is particularly damaging to the public sector, where rigid salary structures prevent the government from competing for the scarce digital talent required to maintain e-Cadastre systems. The observed negative correlation is likely a composite effect of these interconnected challenges: a quantitative increase in education that is hampered by poor governance, a curriculum misaligned with industry needs, and the emigration of top talent.
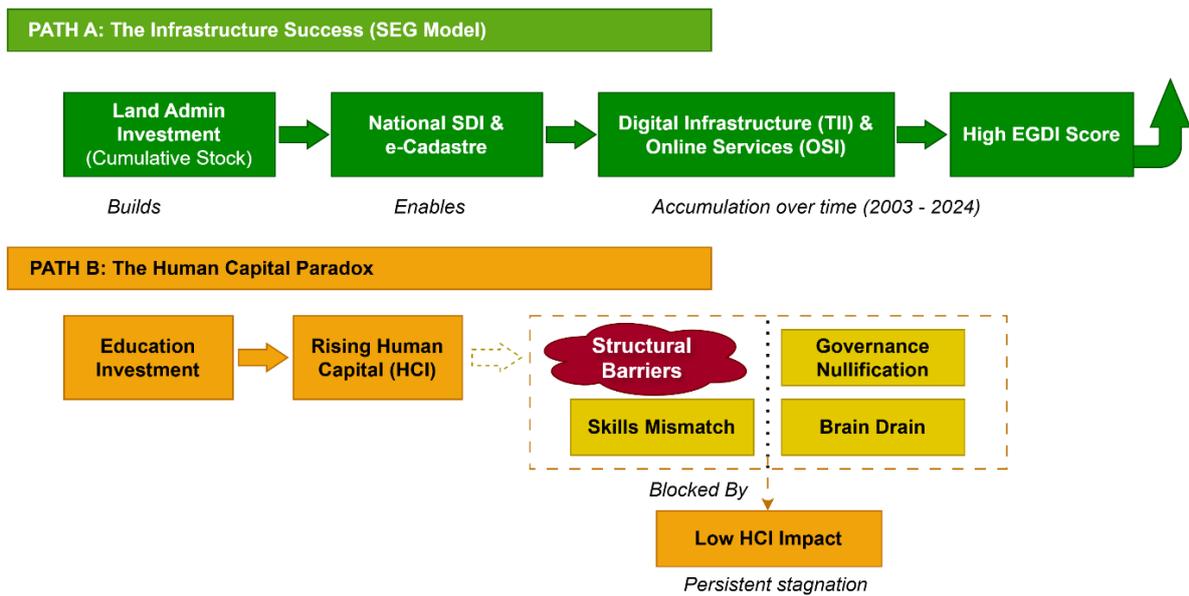
Figure 3: The Divergent Pathways of Ghana's Digital Transformation.

Path A illustrates the 'Spatially Enabled Government' mechanism, where cumulative land investment successfully builds the digital stock (SDI), driving infrastructure (TII) and services (OSI). Path B illustrates the 'Human Capital Paradox,' where educational gains are decoupled from digital performance due to structural barriers such as brain drain and governance failures.

6.3 Ghana's E-Government Performance in a Regional Context

To benchmark Ghana's performance, a comparison with Africa's e-government leaders is necessary. The 2024 UN data reveals that while Ghana is making progress, it lags behind the continent's front-runners.

Table 5 – Comparative EGDI Sub-Index Analysis of African E-Government Leaders (2024)

Country	*Overall (2024)*	*EGDI (2024)*	*OSI*	*TII*	*HCI*
South Africa	40	0.8616	0.8872	0.8951	0.8026
Mauritius	76	0.7506	0.5903	0.9159	0.7456
Tunisia	87	0.6935	0.5951	0.8357	0.6496
Seychelles	92	0.6773	0.4638	0.8913	0.6769
Ghana	**108**	**0.6317**	**0.6084**	**0.7281**	**0.5586**
Kenya	109	0.6314	0.7770	0.5901	0.5271
Rwanda	118	0.5799	0.8206	0.3724	0.5467
Data sourced from the UN E-Government Knowledgebase (EGOVKB) (2024b, 2024c, 2024d, 2024e, 2024f, 2024g, 2024h).					

This comparative analysis is highly diagnostic. For instance, Rwanda's exceptionally high OSI (0.8206), despite a much lower TII (0.3724), suggests a highly effective, demand-driven strategy for online service development that Ghana could learn from, potentially overcoming the limitations of a supply-driven approach where technology is deployed without sufficient focus on citizen utility (Kalashnik, 2024). South Africa and Mauritius have become the first African nations to enter the "Very High" EGDI group, demonstrating strong, balanced performance across all indices that sets a new benchmark for the continent (Ecofin Agency, 2024). Ghana's OSI is competitive, but its HCI is notably the second lowest among this peer group, reinforcing the HCI paradox as a critical area of weakness.

7. CONCLUSIONS AND STRATEGIC POLICY IMPERATIVES

7.1 Conclusions

This study has illuminated the critical and complex influence of land administration in shaping Ghana's e-government performance over the past two decades. The findings confirm that LA modernization, through the development of a national Spatial Data Infrastructure, is a crucial driver of e-government success, directly enhancing the country's telecommunication infrastructure and online service delivery capabilities. This provides a clear, evidence-based pathway for other developing nations seeking to leverage foundational data systems for digital transformation.

However, the paper's most significant contribution is the identification and deconstruction of the Human Capital Paradox. The counter-intuitive negative correlation between e-government progress and the Human Capital Index reveals a profound developmental challenge. It demonstrates that national investments in education are failing to translate into the expected digital dividends. This failure is not a statistical anomaly but a symptom of a tripartite structural crisis: a governance nullification effect that stifles talent, a persistent skills mismatch between education and industry, and a debilitating brain drain of skilled professionals.

While Ghana's overall progress is commendable, its digital future is at risk. Stagnation in citizen-centric online service delivery, persistent cybersecurity vulnerabilities, and, most critically, an inability to harness its human potential threaten to derail its digital transformation agenda (Mahlangu et al., 2025). To safeguard its progress and unlock its full potential, Ghana must move beyond purely technological solutions and undertake deep, cross-sectoral reforms that address the structural factors undermining its greatest asset: its people.

7.2 Recommendations

Based on the empirical findings and the theoretical analysis presented in this paper, Table 6 presents strategic policy recommendations proposed to guide Ghana's future e-overnment strategy. These recommendations are designed to be targeted, actionable, and directly linked to the evidence uncovered in this research.

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Table 6 – Strategic Recommendations for Enhancing Land Administration and e-Government in Ghana

Recommendation	Description	Priority Level	Suggested Timeframe
Integrate LA with National SDI	Prioritize the finalization of the e-Cadastre not as a standalone project, but as the core of a national Spatial Data Infrastructure (SDI). This SDI should provide foundational data for other e-government services like e-taxation, e-planning, and public asset management, following the Spatially Enabled Government model (Wallace et al., 2010).	High	The strong positive correlation between LA improvements and the TII and OSI sub-indices demonstrates that LA is a foundational infrastructure. The SEG theory provides the causal mechanism for this relationship.
Address the Human Capital Paradox	Launch a cross-ministerial task force involving the Ministries of Education, Labour, and Communication and Digitalisation. This task force must act on the findings of the 2025 Skills Mismatch Survey (Education, Labour, Communication) to radically align educational curricula with digital economy needs and develop concrete policies to mitigate brain drain, such as creating competitive domestic opportunities and engaging the diaspora (Twum & Weinreich, 2025).	High	This is a direct response to the paper's central finding: the significant negative correlation between the HCI and e-government progress. This indicates that educational investment is not yielding expected digital dividends due to structural failures in governance, skills alignment, and talent retention.
Adopt Demand-Driven Service Design	Shift strategic focus from technology deployment ("supply-driven") to citizen-centric service design ("demand-driven"). Mandate usability studies, citizen feedback mechanisms, and	Medium	Ghana's OSI lags behind regional leaders, and African e-government literature points to the frequent failure of

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	iterative development for all new e-government platforms to improve uptake and trust. Learn from the success of high-OSI countries like Rwanda, which prioritize user experience on integrated platforms. (Kalashnik, 2024; EGOVKB, 2024h).		supply-driven models. The comparative analysis shows that a high TII does not automatically lead to a high OSI without a focus on citizen needs.
Strengthen Cybersecurity for Land Data	As land data becomes increasingly digitized and accessible through the national SDI, develop and enforce a robust legal and technical cybersecurity framework specifically for land administration. This is essential to prevent data breaches, protect citizens' property rights, and build public confidence in digital systems (Mahlangu et al., 2025).	High	The literature identifies cybersecurity as a critical challenge for digital LA and a major risk for e-government in general, particularly with the adoption of emerging technologies like blockchain.

By implementing these evidence-based recommendations, Ghana can build upon its infrastructural successes, confront the critical human capital challenge head-on, and chart a more sustainable and inclusive path for its digital future. This will not only improve its global e-government standing but also deliver tangible benefits to its citizens, fostering transparency, efficiency, and equitable development.

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