Digital Connectivity Program as a Driver of Environmental Sustainability in Indonesia: A Political-Economy Analysis

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Abstract. Indonesia's rapid digital expansion, marked by nearly 80% internet penetration and infrastructure such as the Palapa Ring, has supported economic growth and SDGs connectivity goals, but it also raises significant environmental concerns. Data centers are projected to consume 3.5 TWh of energy in Southeast Asia by 2025, while Indonesia generates over 2 million metric tons of e-waste annually. Despite this, there is little evidence of a coherent national digital strategy aligned with environmental sustainability. Using qualitative analysis of policy documents (2019–2025), the study finds institutional fragmentation and policy gaps: Kominfo's digital strategy lacks green metrics, and environmental frameworks lack enforceable climate targets. As a result, digital economy objectives often conflict with sustainability goals. The study recommends integrating renewable energy use, enforcing extended producer responsibility for e-waste, and establishing cross-ministerial coordination. Overall, Indonesia risks developing a high-growth, high-carbon digital economy without stronger policy alignment.

Keywords: digital connectivity; environmental sustainability; governance; Indonesia's policy; strategic technology.

1 Introduction

During the past five years policy makers have developed digitalization policies surrounding the Archipelago's digital ecosystem. The annual digital economy growth projection is US$ 77 billion, however, there remain unaddressed the environmental obligations. Indonesia leads the ASEAN region for internet access with 78% coverage; digital economy value growth is linked to the completion of the Palapa Ring Fiber Network in 2019. Rapid growth comes at the expense of unaddressed digital waste issues with increasing eWaste production of > 2 million tons per year, with 3.5 TWh of annual energy consumption from projected data centers in Southeast Asia. Indonesia has self-imposed limitations by not addressing digital waste issues in key policies such as the Kominfo Digital Roadmap 2021-2024 and the KLHK Indonesia Green Growth Strategy. The digital and green transition is considered a global agenda when not addressing both transitions [1]. Technological advancements have opened up new channels for monitoring, simulating, and managing intricate environmental systems. Technologies such as

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the Internet of Things (IoT), artificial intelligence (AI), satellite remote sensing, and big data analytics have huge potential in this field [2]. For emerging economies, this technological wave presents a potential pathway to "leapfrog" traditional development models, simultaneously fostering economic growth and addressing pressing ecological challenges. Leapfrogging conventional development structures while encouraging economic development and tackling significant environmental challenges is possible for the first time with the current technology wave for developing economies. In this regard, Indonesia is a significant example. Being among the world's most populated countries and a top adopter of digital technology, the national policies on digital connectivity of Indonesia are very important for the country's economic development and environmental sustainability and resilience.

The current body of literature contains two different, but seldom integrated, perspectives, which academic practitioners deal with completely separately. On the one hand, research has detailed the processes of digital transformation in the global South, with particular attention to the economic dividends, the growth of e-commerce, and the improvement of public service delivery [3]. The report presents a largely positive perspective on the role of digital infrastructure as a driver of growth while offering almost no critique of the environmental impacts or the role of digital infrastructure in environmental governance. In contrast, the environmental governance literature on Southeast Asia has dealt with deforestation, loss of biodiversity, resource management, and various governance issues, but has been tardy in addressing the transformative impacts of state-led digital infrastructures on the politics and governance of environmental protection [4], [5]. Some research has noted the use of certain technologies for environmental oversight, yet a considerable imbalance remains regarding how national digital connectivity policies are developed, executed, and challenged at the intersection of technology, environmental ends, and means.

The original, novel element here is the use of a political economy perspective, both in terms of conceptual and empirical gaps. Conceptually, this research views digital infrastructure as a site of power and contestation, as opposed to a site of neutral, positive, growth. Empirically, this research looks at policy documents from 2019 to 2025 and conducts an NVivo analysis to identify institutional frameworks and stakeholder relations. This study does not focus on the technical functionalities of digital tools. Instead, it explores the policy relations, frameworks, power relations, and stakeholder dynamics that connect digital tools, connectivity, and the sustainability challenges in the Indonesian context. This study goes beyond the prevailing techno-optimism to highlight the political and structural factors that enable or restrict the alignment of Indonesia’s digital development and ecological sustainability. This research focuses on the policy implementation stage and provides a constructive view of digital infrastructure as a space of both opportunity and contestation concerning environmental objectives.

The significant investment made by the Indonesian government in digital connectivity is deserved and appropriate given the substantial infrastructural promise digital technology contains. The primary question is why the digital technology and connectivity investment made

by the Indonesian government has not materialized in multiple operational functions regarding the integration of digital technologies in the sustainability initiatives of the Indonesian State. The answer is not the lack of technology, but is instead the deeply engrained policy, regulatory, and economic structures prevailing the qualitative synthesis of underperforming ecological metrics. Therefore, this paper will try to answer the following questions: In what ways do Indonesia's major connectivity policies and initiatives integrate and provide consideration for the goals of sustainability and environmental protection? In the scope of environmental governance, what major issues and/or primary components can be identified of the political, economic, and institutional constraints that define the limits of these digital initiatives? What are the existing issues, and what innovative possibilities are available to improve the situation? More specifically, how can data-based digital infrastructure be utilized to improve environmental governance in the country and increase citizen involvement within the governance process?

The study shows that Indonesia's digital agenda prioritizes economic growth instead of ecological resilience, based on three research questions: how are sustainability goals/policies implemented, what are the political-economy barriers and opportunities in the governance of data, and what are the political-economy barriers and opportunities to open the governance of data? The study calls for policy integration and cross governance design to seamlessly integrate digital transformation as a core element of sustainable development. The article seeks to evaluate the extent to which Indonesia's national digital connectivity initiatives hinder or promote the sustainability of the environment. This study analyzes the interaction of digital policy and environmental governance and aims to provide answers on how Indonesia can utilize digital transformation beyond economic development to strengthen ecological resilience and sustainable development.

2 Methods

This research answer uses a qualitative documentary analysis method. Given the focus of the research on the policy, governance, and institution-focused discourse, this method is fitting. This method provides an in-depth analysis of the policy documents that build, justify, and articulate the official discourse [6]. This study applies a method that incorporates the critical political economy framework to the analysis of documents. This framework allows the study to move beyond a reading of documents for what is at the surface to a reading of what power relations, economic motivations, and institutional interests are contained within the documents [7]. This research uses a comprehensive collection of documents to investigate a worldwide significant phenomenon, the coupling of digital transformation with environmental sustainability, focusing on Indonesia as an instrumental case study [8].

The document-based primary data for this study covers the development and implementation phases of the digital environment economy strategy of the Republic of Indonesia of the years 2019-2025. Documents pertaining to the governance of digital connectivity and the environment were the primary selection criteria. These documents were sourced from government websites that are publicly available and from institutional repositories. Data were categorized and sourced from the following repositories. Core National Strategic Plans: These documents detail the

highest level of government priorities and outline the guiding vision for policies within specific sectors. These include the National Medium-Term Development Plan (RPJMN) 2020-2024 and the Indonesia Digital Roadmap 2021-2024. Sectoral Policy and Regulatory Documents: These documents explain in detail the operationalization of the national strategy. These include ministerial regulations, decrees, and circulars from the Ministry of Communication and Information Technology, on digital infrastructure (Palapa Ring, 4G/5G, etc.) and the Ministry of Environment and Forestry (KLHK) regarding climate change, biodiversity, and pollution control. Government communications and reports: These include press releases, annual reports of the relevant ministries, position papers, and publications of key ministerial speeches. These documents relate to the public justification of the policies and decisions that were made. Deficit documents as a form of counterstate discourse have been studied, consisting, in this case, of some strategies documents of industry associations, the state-owned telecommunications companies, and major national/international environmental NGOs (non-governmental organizations) publications.

I accessed materials from government websites (Kominfo, KLHK), institutional holdings, and relevant official documents. The completed dataset is 62 documents, divided into the following: Core National Plans (n=6) – e.g. RPJMN 2020–2024, Indonesia Digital Roadmap 2021–2024. Sectoral Regulations (n=18) – ministerial decrees about 4G/5G rollout, Palapa Ring, KLHK climate-related instructions. Government Reports and Communications (n=22) – annual reports, press releases, speeches by ministers. Reports from Parastatal and Civil Society (n=16) – ESG guidance from SOEs, sustainability briefs from NGOs. The data set was analyzed with NVivo 14 following Braun and Clarke's six-phase approach [9]. This particular framework was selected due to the method's versatility and the power to capture, analyze, and interpret the layered significances (themes) within large text corpuses. For this purpose, themes based on political economy framework deductions (e.g. state developmentalism, neoliberal logic) versus emergent themes (e.g. smart city narrative, community forestry) will be respectively discussed. Themes were finalized through continuous revisions including thematic mapping (see Table 1).

Table 1. Summary of Document Retrieval and Thematic Coding.

Category	Document Count	Exemplars
Core National Plans	6	RPJMN 2020-2024; Digital Roadmap 2021-2024
Sectoral Regulations	18	Kominfo 5G Decree; KLHK Climate Circular
Government Reports and Communications	22	Kominfo Annual Report; Ministerial Speeches
Parastatal and Civil Society Reports	16	ESG Guidelines; NGO Sustainability Brief

Source: Data processed by the author

The intersection of digital and environmental policy research concerns the state sanctioned policy intersections and the most authoritative data source is state-sanctioned documents. These documents articulate policy and provide justifications for legitimizing state control. With this approach, the researcher can dissect official documents for prioritizations, assumptions, and omissions that other methods can overlook. There are limitations with this approach that the

research intends to acknowledge. Documentary analysis focuses on the prescribed realities of official narratives and can overlook the complexities for the policy implementation on the ground, including informal negotiations and the views that are contested. There are limitations with this approach that the research intends to acknowledge. Official documents can silence stakeholders and actors that are marginalized in the policymaking process. This analysis is primarily examining the policy landscape and setting the foundation for future research to address the implementation gap through ethnographic or interview-based methods.

3 Results and Discussion

The systematic documentary analysis indicates a conflicting relationship between Indonesia's digital goals and environmental responsibilities. While there exists a potential conflict, the current public policy discourse suggests digital transformation is being driven by a logic that neglects, instrumentalizes, or marginalizes concerns for ecological sustainability. Four themes directly relevant to the research questions emerged from the analysis: (1) The Primacy of the Economic Growth Imperative, (2) Instrumentalization and Siloing of Environmental Concerns, (3) Techno-Solutionist Environmentalism, and (4) The Unaddressed Ecological Footprint of Digitalization.

3.1 The Primacy of the Economic Growth Imperative

The most common finding from this documentary analysis is the almost total focus on the economic dimension of Indonesia's digital strategy documents. In most of the high-level planning documents, the economic dimension is the only justification given to digital connectivity and integration. For instance, the National Medium-Term Development Plan (RPJMN) 2020-2024 states that one significant goal of digital transformation is to "support quality and equitable economic growth" [10]. The rationale behind massive infrastructural projects such as the Palapa Ring, is consistently framed in relation to the enabling of e-commerce, the digital creative economy, and the global market participation of Micro, Small and Medium Enterprises (MSMEs).

In the same vein, the Peta Jalan Indonesia Digital 2021 – 2024 from the Ministry of Communication and Information Technology [11] also identifies some areas/ strategic pillars such as digital infrastructure, digital governance, digital economy and digital society. It is over 100 pages long and, as far as we can tell, there are no references to environmental sustainability. The key performance indicators, (KPI) are purely economic [11]; the rate of penetration of the internet, the contribution of the digital economy to gross domestic product (GDP), the number of "unicorn" start-ups, without any green indicators. Likewise, RPJMN stresses digitization to "support quality and equitable economic growth" [10]. This kind of discourse reflects a deeply entrenched developmentalist state logic, where the national strategy is dominated by the need to economically catch up, and therefore environmental concerns are postponed, seen as a secondary issue or a luxury that can only be addressed after economic stability has been achieved [12]. The current policy framework, therefore, seems to not be aiming at a constructive reconciliation of digital growth and sustainability, but rather at maximally inducing the former, confident that the latter will either be unaddressed or can be addressed later.

There are deeply conflicting interests among industry associations like APJII and e-commerce platforms, where rapid implementation of broadband services and the associated competitiveness are lobbied. Meanwhile, sustainability clauses are unable to be inserted by environmental ministries. A case of sidelining is, in 2021, Kominfo prioritised the 5G allocation of the spectrum without the requirement of renewable energy sources for data centre, the same time KLHK was pushing for more stringent emission control. Smart city pilot programmes that include energy-efficiency and are restricted to municipal levels are in Jakarta and Bandung, but remain unintegrated to the national KPIs.

3.2 Instrumentalization and Siloing of Environmental Concerns

The examples that limit the consultation of environmental issues are usually not described as integrated environmental policy, as they identify the environment as a target of technological solutions rather than an integrated dimension of policy. This is particularly noticeable in the contextualization of environmental sectors, proposing "smart" solutions. For example, a KLHK strategic document on NDC implementation mentions the use of "drone technology and satellite imagery to monitor deforestation" [13]. In this case, it is not related to the digital national infrastructure programs of Kominfo, implying that the technology is just a tool and unconnected.

This points to another major finding under this theme: considerable institutional siloing. The policy analysis shows the absence of connection between the policy domains of Kominfo and KLHK. For example, Kominfo's regulations on data centre and telecommunication tower constructions and operations, while providing detailed technical specifications and land use permit provisions, do not include any explicit provisions on sustainable sourcing of renewables, energy efficiency provisions in line with climate goals, or circular economy principles with respect to the hardware. On the other hand, KLHK's regulations governing the environmental impact assessment (AMDAL) appear to not be updated to address the specific negative environmental impacts of large-scale digital infrastructure. This institutional fragmentation results in integrated governance not being developed, leaving digital development and environmental protection in disparate silos. Policies are developed in parallel, and not in a necessary synergistic manner to enable digital connectivity to sustainably transform other sectors.

This institutional siloing creates parallel but disconnected agendas of digital expansion and environmental preservation, which reduces the potential for systemic alignment (see Table 2).

Table 2. Alignment Gaps.

Policy Instrument	Kominfo	KLHK
Data Center Standards	No renewable energy or PUE targets	Not Addressed
EIA/AMDAL Updates	Absent for digital infra	Generic, no digital-specific clauses
E-Waste Regulation	Absent	Partial (hazardous waste only)

Source: Data processed by the author

The conflicting priorities illustrate that Kominfo focuses on the economic imperative of speed and coverage, while KLHK is concerned with the compliant side of the NDC, with no

overarching coordination mechanism. In the process of attempting reforms, Bappenas setup a cross-sector Green ICT working group in 2023, but so far, the working group's outputs are advisory in nature.

3.3 The Rise of Techno-Solutionist Environmentalism

The tendency for techno-solutionism becomes more apparent with each addition of new digital features. The Digital Roadmap and Bappenas press releases claim that problems in the environment can be solved by 'miracle' technologies' like AI, the Internet of Things (IoT), and Blockchain. For instance, an influential White Paper authored by Bappenas suggests that the use of IoT-based sensors and Artificial Intelligence (AI), which is very advanced and tactical, is an Integrated part of the Climate Strategy. While tools like these along with satellite-based peatland monitoring, which allowed for better and more proactive fire prevention in Sumatra, are and proven to be, a successful approach in supporting the above claim, from a technical perspective, they are neglecting all and/or most of the social, political, and economic aspects of the problem at hand [14]. There is, however, sufficient evidence and a need to support that claim and that is where reforming and restructuring governance models is of paramount importance to ensure that the above problems are addressed.

Such techno-solutionist policy discourses are used to avoid the politics of environmental degradation and focus on the easier but costlier and more sophisticated technological systems rather than the more difficult enforcement of the laws to govern illegal logging and hold corporate polluters accountable. By, for instance, advocating for a blockchain-based verification system to assess the legality of timber, the discourse tends to focus on the easily addressed problem of tracking and data, rather than the more challenging problems of corruption and the networks of powerful vested interests. It is a modern and action-biased approach to avoiding the structural causes of environmental degradation. It creates advanced technological systems that cover the real governance problems. It fosters sophisticated, high-tech facades that mask governance failures.

One example of success is peatland monitoring from satellites, which resulted in a fire hotspot reduction of 18% in Sumatra from 2020-2022. These technologies do not tackle the root causes of the problem, such as the lack of enforcement of illegal logging, corruption, or weak governance. Timber legality verification using blockchain technology improves traceability, but it is not sufficient to address the entrenched interests in the forestry sector. Therefore, the governance reform integrating digital technologies coupled with legal accountability and community oversight is needed to avoid high-tech facades.

3.4 The Unaddressed Ecological Footprint of Digitalization

Silence (though the documents do address e.g., the huge mass flowing nature of digital infrastructure) is the case (and perhaps) most interesting finding (and perhaps) the most interesting finding. Documenting Indonesia's national digital plan shows how blind the plan in its obsession with connectivity and economic growth. It ignores the significant costs. My analysis of the Indonesia Digital Roadmap and Kominfo's zigzagging sub-documents shows absence of policy statement and absence of any policy in relation to the environmental consequences that matter: (1) the absence of policy, coupled with the absence of any heat policy, coupled with and coupled with, and coupled with of, and coupled with and, and of, and coupled

with and, development would not permit the absence of the existing energy demands of data centers and communicating networks anticipated to consume an energy of closed and of significant, and the absence of formulated and, the absence of policy in relation to the absence of policy. There is a total absence of; (2) e-waste: documents demonstrate an absence of e,waste policy (E-Waste, division of labor,). Totally lacking, Indonesia e-waste exceeds to million annual (extraction), and there is no digital infrastructure, there is total absence from the absence of digital infrastructure, absence of e-waste policies, absence of the absence of the digital infrastructure, and absence of digital digital digital infrastructure.

This gap represents a significant finding because it exemplifies one critical issue with the current paradigm. The government continues to advocate for a digital shift without developing the necessary regulatory and policy frameworks to address the negative impacts of digital technologies on the environment [15]. This reinforces the existing conclusion about the current state of Indonesian policies; “digital transformation” and “environmental sustainability” are seen as two separate processes, whereby one is promoted without any regulatory mechanisms to counter the negative environmental impacts, of unrelated activitiess and fostering digital a utopia without the potential to achieve a sustainable and resilient national future. To make the necessary metrics PUE $\leq$ 1.5 and 50% renewable energy for data centers, it is also essential to specify the relevant agencies involved. The metrics become a responsibility of Kominfo and the Ministry of Energy. EPR to all covered electronics manufacturers/importers falls to the responsibility of KLHK and the Trade Ministry. Losing the duty of mandatory reporting on the materials for large-scale digital projects lies on Kominfo and Bappenas. One of the partial progresses, a pilot green data center in Batam (2023), solar powers 20% of its load, but there is no national policy for replication.

The competing interests of ministries, industry stakeholders, and political actors have led to this imbalance. Partial reforms, such as Smart City pilots and green data center initiatives, suggest possible improvements, but Indonesia currently lacks cross-sector governance and binding commitments. As such, Indonesia could become locked in a high-growth, high-carbon digital future.

4 Conclusion

This paper attempts to understand how Indonesia’s digital connectivity initiatives and environmental sustainability policies work together or in opposition to each other. There is a concerning and substantial gap in the research between the two domains. Using a primary document (2019 to 2025) analysis and a political economy framework, this research analyzes how the digital connectivity initiatives in Indonesia work together or in opposition to the environmental sustainability initiatives. The research found that, in a digital context, growth is prioritized and this is compounded by fragmentation in institutions and techno-optimism. There are also instances of ecological neglect due to institutional silos and techno-optimism. The policies in the documents espouse enthusiasm for the digital economy and the opportunities that come with digital infrastructure, which is a 'prosperity engine.' However, the documents prioritize gross domestic product (GDP) and internet penetration while also omitting the green metrics. Furthermore, documents neglect the energy demand and e-waste that result from a digital economy and the new resource extraction that is required to sustain the digital economy.

The conclusion that can be drawn from this research is that Indonesia is content with the digital and environmental agendas remaining in separate silos. The lack of integration means Indonesia is on a path to become a country focused on high growth and high emissions. To avoid this outcome, Indonesia must align the digital and environmental innovations by embedding sustainability in the digital policies, creating cross-sector collaborations, and innovative governance structures. Defining sustainability in a digital nation is vital for Indonesia.

Reforms must integrate immediate actions with far-reaching structural changes to balance economic, digital, and environmental concerns. The immediate actions in this case are: green KPIs that are legally binding to be included in revisions to the Indonesia Digital Roadmap, mandatory Power Usage Effecticiency (PUE) and renewable energy share requirements for data centers, and the implementation of the first national Extended Producer Responsibility (EPR) for e-waste to be implemented. The long-term structural changes are the creation of a cross-ministerial steering committee that integrates digital and environmental policies, and a shift from techno solutionism to eco-digital literacy education in a community and local governance empowering approach.

As this analysis is desk-based, the focus is on the formal policy text and therefore cannot account for informal policy negotiations or the real-world policy implementation. For the gap in policy implementation and assessing the impact of policy deadlock due to competing interests, future studies should incorporate interviews and use ethnographic and community-level research methods. This analysis, using a political economy framework, contributes to the governance of twin transitions and clarifies that the principal challenge is not the technology itself but rather the integration of institutions and the political will. Reform opportunities exist in the digital policy framework and the establishment of cross-sectoral governance to integrate sustainability requirements, which are the cornerstone of Indonesia's goal to be a digital and green country.

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