

DIGITAL HEALTH GOVERNANCE WITHIN THE ARCHITECTURE OF STUNTING PREVALENCE MITIGATION: A CONVERGENCE OF DATA INTEGRATION, TECHNOLOGICAL INNOVATION, AND PUBLIC POLICY DYNAMICS

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Abstract This study aims to explore in depth the architecture of Digital Health Governance in constructing an integrated, ethical, and evidence-based framework for stunting mitigation in West Nusa Tenggara Province (NTB), Indonesia. Employing a qualitative-descriptive approach with a case study design, the research focuses on the dynamic interrelations between digital technology, health bureaucracy, and beneficiary communities. Data was collected through in-depth interviews, participatory observations, and analysis of policy documents and digital systems (including SIGIZI, e-PPGBM, SIGA, and the NTB Stunting Dashboard), and subsequently analyzed using thematic and source triangulation techniques. The findings reveal that cross-sectoral data fragmentation, digital literacy disparities, and weak ethical data regulations constitute major structural barriers to the implementation of digital health governance. Nonetheless, significant opportunities arise from the strengthening of data interoperability and pentahelix collaboration, enabling early detection and rapid response to stunting risks. The study concludes that socio-technological resilience and digital equity are the pivotal determinants for successful stunting mitigation in the digital transformation era. The research recommends the establishment of a federated data system-based Digital Health Governance ecosystem that ensures data sovereignty, policy transparency, and sustained community participation.

Keywords; Digital Health, Governance, Mitigation, Stunting Prevalence, Public Policy.

1. Introduction

Digital health has emerged at the very vanguard of global health system transformation, transmuting into a strategic armamentarium for the mitigation of public health crises ; ; ; ; ; . Through the confluence of information technologies and artificial intelligence (AI), functions once deemed logistically intractable digital contact tracing, anticipatory diagnostics, integrative health data management, and even epidemic prognostication are now executed with unprecedented velocity and precision ; . This metamorphosis is not a spontaneous or organic evolution; rather, it is the deliberate outgrowth of active synergies between state and non-state actors, undergirded by normative and technical scaffolding provided by multilateral institutions such as the World Health Organization (WHO) ; ; ; .

Indeed, WHO in concert with transnational financing entities such as the Global Fund, has impelled low- and middle-income countries (LMICs) to institutionalize national strategies for digital health . This policy architecture is conceived as catalytic for expediting universal health coverage and the realization of the Sustainable Development Goals (SDGs) ; ; ; . Yet, beneath these transformative vistas lurks an unassailable caveat: the United Nations Special Rapporteurs have forewarned that digital technologies, if orchestrated without equity and prudence, may exacerbate entrenched inequalities and infringe upon the socio-economic rights of vulnerable populations ; ; .

At the epicenter of this conundrum lies the digital divide, a formidable impediment to equitable access to digital health services ; . Hence, what is

imperative is not merely the diffusion of technology, but the institution of robust, distributive, and ethically anchored digital health governance. Frameworks such as the Health Information Governance Architecture Framework (HIGAF 2.0), advanced by the Asian Development Bank, epitomize an adaptive and strategic governance schema ; ; ; ; . By privileging enterprise-level perspectives and cost-efficient investment logics, digital health transcends its auxiliary role to constitute a foundational pillar in the construction of resilient, inclusive, and futurity-oriented health systems ; . Within the ambit of crisis mitigation, digital health is thus no less than a principal arsenal for detection, response, and prophylaxis of global health emergencies .

Nevertheless, amid the accelerating digitization of the health sector, non-digital governance lacunae remain obstinate constraints, particularly in tackling the persistence of stunting prevalence in LMICs ; ; ; ; ; ; ; ; . The absence of transparent, accountable, and participatory governance structures frequently nullifies the effectiveness of stunting interventions, even when buttressed by digital technologies ; ; ; . Fragile regulatory regimes over personal data protection, enfeebled ethical oversight, and attenuated digital literacy collectively engender fissures that imperil the translation of data into actionable, evidence-based policy ; ; . In contexts where interventions are cross-sectoral and targeted at vulnerable populations, such governance fragilities magnify inequities. Data amassed from children and households, when harvested without stringent ethical controls, risks misappropriation or leakage, thereby corroding public trust in health institutions . Empirical inquiries affirm that although mobile health (mHealth) technologies have been mobilized for monitoring and reporting, the absence of audit mechanisms, data verification protocols, and responsive feedback loops severely erodes the credibility of interventions ; .

Accordingly, the research problem animating this inquiry may be distilled thus: *What is the integrative role of digital health governance in engineering an ecosystem for stunting prevalence mitigation in Nusa Tenggara Barat (NTB), when confronted with the exigencies of cross-sectoral data integration, regulatory certainty in public policy, and technological implementation that guarantees security, ethics, and sustainability of individual-level data amid systemic capacity deficits and pronounced digital inequalities?*

The urgency of interrogating digital health governance within the ambit of stunting mitigation is acute, especially in fragile health systems of developing economies such as Indonesia [6]. While digital health approaches possess the potential to accelerate systemic reforms and propel SDG attainment, without judicious governance, these very transformations may aggravate inequality ; . The European Union's experience with the General Data Protection Regulation (GDPR) illustrates that even sophisticated regulatory regimes are beset by disjunctures between normative commitments to data protection and the fluid, expansive realities of digital health technologies ; . In NTB, frail policy harmonization, health data fragmentation, and the absence of an entrenched legal-ethical scaffolding render digital governance indispensable. Absent a comprehensive framework such as HIGAF 2.0, technological incorporation into stunting interventions risks being sporadic, non-systemic, and unsustainable.

The novelty of this study inheres in its endeavor to graft the conceptual architecture of digital health governance onto the specific problem-space of stunting mitigation, hitherto predominantly interrogated through the prism of non-digital governance modalities such as participatory community mobilization or

manual social audits. Whereas antecedent scholarship has valorized analog mechanisms like Community Score Cards and citizen reporting, this research advances a paradigmatic leap by integrating Information and Communication Technologies (ICTs), big data analytics, and governance architectures (e.g., HIGAF 2.0) to rationalize intervention efficiency.

Within the broader literature, ICT-mediated governance has demonstrably curtailed corruption and enhanced transparency as evidenced by platforms such as *ipaidabrike.com* and *U-Report*. Yet, a systemic governance paradigm explicitly tailored to digital health and specifically calibrated for stunting mitigation in fragile geographies such as NTB remains conspicuously absent. Herein lies the scholarly and practical novelty of this research: the proposal of a digital data governance schema attuned to local socio-political dynamics, acutely sensitive to the ethical vicissitudes of personal data use, and resilient to structural deficiencies in health data regulation deficiencies that even GDPR has yet to fully surmount. This inquiry, moreover, expands the academic horizon by suturing the oft-disjointed domains of regulation and technology through a transdisciplinary lens that amalgamates public policy, cybersecurity, cross-sectoral data integration, and information ethics.

2. Method

This study was designed using a qualitative descriptive approach anchored in a case study design, epistemologically chosen for its capacity to unravel the concealed layers of Digital Health Governance practices within the framework of stunting prevalence mitigation in West Nusa Tenggara Province (NTB). The approach is positioned not merely as a phenomenological exploration technique but as a critical instrument for constructing a holistic understanding of stunting as a multidimensional phenomenon. Stunting is not simply reduced to a chronic nutritional deficit; rather, it is conceptualized as a structural problem intersecting with the digital policy ecosystem, the configuration of health information governance, and the socio-political interactions among bureaucracies, technologists, and beneficiary communities. Accordingly, the case study design is deemed strategic as it allows for the tracing of these complex interactions in depth and within context, emphasizing the relational dynamics between digital infrastructures, bureaucratic structures, and social agents engaged in the implementation of technology-driven stunting mitigation policies.

Data collection was conducted through complementary multiple strategies, namely in-depth interviews, participatory observation, and the review of digital documents and public policy texts. Interviews were directed at key stakeholders selected via purposive sampling, including officials from the Provincial Office of the National Population and Family Planning Agency (BKKBN NTB), the Health Office, e-health system developers/ Department of Communication, Informatics, and Statistics of West Nusa Tenggara Province, frontline health workers, community health cadres (*posyandu*), and beneficiary households. Participatory observation was employed to disentangle the practices of digital health application usage, enabling the researcher not only to acquire technical descriptions but also to capture the socio-symbolic meanings ascribed by users. Document analysis encompassed the review of digital data (e-stunting dashboards, integrated nutrition information systems, and policy reports), complemented with normative policy documents at both national and regional levels. All data were subjected to rigorous

triangulation to ensure interpretive validity, mitigate institutional bias, and test the consistency between technocratic narratives and lived experiences of field actors.

The stages of data analysis were carried out through a thematic qualitative procedure operationalized via open, axial, and selective coding, enabling the systematic identification of major themes such as technological accessibility asymmetry, the meaning-making of digital interventions, socio-technological resilience, and the bureaucratic digital power nexus. The interpretive process was focused on deconstructing the structures of power relations underpinning digital health governance practices, carefully weighing the simultaneous dynamics of inclusion and exclusion. From this interpretive exercise, the study generates critical reflections crystallized into policy recommendations grounded in the principles of digital inclusion, data ethics, and local empowerment.

3.Result

The phenomenon of stunting in Indonesia can no longer be reduced to a purely technical biomedical issue of nutrition; rather, it must be understood as a multidimensional tragedy that reflects a collective failure in the governance of human development ; ; ; ; The prevalence of stunting, which continues to exceed the threshold of international public health tolerance recorded at 21.6% in 2022 constitutes a structural indicator that Indonesia is grappling with a latent, systemic crisis. This condition reveals deeply embedded vulnerabilities within the ecosystems of health, education, and household economics, perpetuating the intergenerational reproduction of inequality. Stunting not only diminishes the cognitive and physical capacities of children but also crystallizes the collective marginalization of a population segment that should serve as the nation's demographic dividend. Without mitigation through integrated cross-sectoral strategies, the much-anticipated demographic bonus risks being transformed into a "demographic disaster," wherein the productive generation is dominated by individuals constrained by physical, mental, and social limitations.

The situation becomes more acute when considering regional disparities, particularly in West Nusa Tenggara (NTB), which has consistently ranked among the provinces with the highest stunting prevalence in Indonesia. The Indonesian Nutritional Status Survey (SSGI) recorded stunting prevalence in NTB at 32.7% in 2022, which declined to 24.6% in 2023, then increased to 25.9% in 2024. Alarmingly, in 2025 the rate surged again to 28%, far exceeding both the national target of 18.8% for that year and the long-term vision of reducing stunting to 5% by 2045. These fluctuations are not mere statistical artifacts but tangible indicators of an ongoing public health emergency overshadowing NTB. They reveal an entrenched structural crisis, exacerbated by unequal distribution of health services, inadequate nutritional infrastructure, limited family health literacy, and household economic dependence on fragile informal sectors. This reality underscores a paradox of development: while NTB is frequently promoted as a region with progressive tourism and creative-economy potential, its children the symbolic custodians of generational continuity remain ensnared in cycles of chronic nutritional deprivation. In the global horizon, NTB's high stunting prevalence positions the region at risk of falling into a developmental trap, as its human resources face diminished competitiveness in an increasingly knowledge- and innovation-driven global economy.

More profoundly, the massive prevalence of stunting in NTB and across Indonesia should be interpreted as an indicator of "biopolitical failure," where

existing public policies have yet to orchestrate effective integration between nutritional interventions, maternal and child health, sanitation, and socio-economic empowerment. The looming risk extends beyond elevated morbidity and long-term mortality to the construction of a “fragile generation” incapable of bearing the weight of modernity. In the long run, the nation’s inability to break the cycle of stunting will give rise to layers of population with diminished cognitive capacity, limited productivity, and heightened vulnerability to exploitation within global markets. In NTB, where stunting prevalence is higher than the national average, the risk is even more severe, as the erosion of human capital directly undermines the region’s socio-economic resilience against crises triggered by climate shocks, disasters, or national economic volatility. Accordingly, stunting must no longer be confined to the realm of health agendas but redefined as an existential national problem requiring a paradigmatic shift from technocratic rhetoric toward transformative biopolitical action one that courageously transcends bureaucratic, technological, and social boundaries.

Within the conceptual horizon of Digital Health Governance, the mitigation of stunting prevalence cannot be reduced to a matter of linear technological capacity but must be situated within an epistemological complexity that encompasses data integration, technological accessibility asymmetry, socio-technological resilience, and the bureaucratic digital power nexus as structural determinants. The interoperability of cross-sectoral data architectures linking health departments, e-health applications, and integrated nutrition information systems functions not merely as a repository of information but as a hegemonic arena shaping the quality of federated systems and big-data harmonization in public policy. This interoperability serves as an epistemic matrix that reveals how inter-agency integration not only facilitates informational consistency but also constructs bureaucratic legitimacy in producing evidence-based decisions. At the same time, technological accessibility asymmetry emerges as an inherent paradox: while digital interventions are designed to be inclusive, the digital divide between bureaucratic actors, health workers, and user communities engenders differentiated access, thereby transforming the ideal of inclusivity into participatory segregation. This dynamic demonstrates that successful mitigation of stunting through digital platforms requires critical awareness of infrastructure distribution and technological literacy, ensuring that digital representation does not remain the privilege of bureaucratic and technocratic elites but becomes an empowering social instrument for vulnerable populations.

Moreover, socio-technological resilience illuminates the contested interface between the robustness of digital systems against policy fragmentation and infrastructural vulnerabilities, and the adaptive capacities of communities navigating risks of social exclusion. Resilience here is not reductively construed as technical strength but as a hybrid interplay of technological innovation and social adaptation, where failures of regulatory integration can undermine orchestrated interventions. At this juncture, the dynamics of bureaucratic–digital power relations constitute the most subtle yet decisive variable, as the trajectory of stunting mitigation policies is frequently shaped by the tensions between health bureaucracies as regulators, technology developers as innovators, and beneficiary communities as directly affected actors. These power relations transcend mere authority distribution, manifesting as digital biopolitics that determine whether health technologies evolve into instruments of collective empowerment or devolve into mechanisms of new exclusion.

Accordingly, the analytical framework of this study is directed toward unveiling the interconnections among four key indicators data interoperability, technological accessibility asymmetry, socio-technological resilience, and bureaucratic–digital power relations as primary determinants that illuminate both the effectiveness and the paradoxes of digital health governance within the framework of stunting prevalence mitigation.

3.1 Interoperability within Cross-Sectoral Data Architectures in Public Health Governance

The interoperability of cross-sectoral data architectures within Indonesia’s health ecosystem reveals an epistemological paradox between the normative aspiration of integrating public health knowledge and the empirical reality of bureaucratic and technological fragmentation ; ; ; ; . On the one hand, digital health infrastructures ranging from the Integrated Nutrition Information System (*SIGIZI*), locally developed e-health applications such as *STUNRAKA* and *e-PPGBM*, to the databases of the National Population and Family Planning Agency (*BKKBN*) are constructed as technological media to ensure data uniformity, predictive intervention, and the acceleration of stunting reduction targets. On the other hand, the persistence of sectoralized data governance mechanisms, the inadequacy of semantic interoperability, and the scarcity of participatory regulation collectively indicate that cross-sectoral integration has yet to evolve into systemic harmony, remaining instead a form of administrative aggregation vulnerable to duplication and reporting bias.

Within the conceptual horizon of a federated health information system, the ideal scenario is one in which health departments, primary care centers (*puskesmas*), community health cadres (*posyandu*), and digital communities retain sovereignty over their local data while simultaneously enabling real-time cross-platform query synchronization. Unfortunately, in Indonesia, such data federation remains a normative discourse that has not yet matured into operational capacity.

The following table presents the national-level status of health data integration and interoperability across institutions in the context of stunting management in Indonesia.

Table 1. Cross-Institutional Health Data Integration at the National Level in Indonesia

System Component	Institution/Platform	Primary Function	Challenges	Potential for Federated Systems & Big Data Harmonization
Integrated Nutrition Information System (<i>SIGIZI</i>)	Ministry of Health (MoH)	national nutrition surveillance data	Discrepancies in indicators with local datasets; delays in data entry	Potential to serve as the national hub within a federated nutrition data system
<i>e-PPGBM</i> (Community-Based Nutrition Recording and Reporting)	MoH, Primary Health Centers (<i>Puskesmas</i>), Community Health Posts (<i>Posyandu</i>)	Individualized (“by name, by address”) recording of child nutrition status	Input bias; limited digital literacy among community health cadres	Provides granular datasets for machine-learning–based stunting risk prediction
BKKBN – Indonesian Family Data	National Population and Family Planning	Household-level database covering	Fragmentation with MoH datasets;	Enables cross-sectoral integration of family and

System Component	Institution/Platform	Primary Function	Challenges	Potential for Federated Systems & Big Data Harmonization
(<i>Data Keluarga Indonesia</i>)	Agency (BKKBN)	nutrition, sanitation, and reproductive health	differing data standards	nutrition contexts
<i>Satu Sehat</i> (National Health Interoperability Platform)	MoH, BPJS (Social Security Agency), Hospitals	Interoperability architecture for electronic medical records	Standardization challenges (HL7-FHIR); limited regional connectivity	Establishes the technical backbone for a federated national health system
SSGI (Indonesian Nutritional Status Survey)	MoH, Central Statistics Agency (BPS)	National survey of stunting prevalence	Conducted periodically, lacking real-time functionality	Provides macro-level validation for operational big data
Stunting Dashboard – National Development Planning Agency (<i>Bappenas</i>)	Bappenas	Cross-sectoral monitoring of stunting reduction performance	Reliance on sectoral inputs; frequent inconsistencies	Potential integration with AI-driven policy analytics for adaptive governance

Source: Official Document of the Government of Indonesia.

In the context of West Nusa Tenggara (NTB), the persistently elevated prevalence of stunting (28% in 2025, significantly above the national average) constitutes a living laboratory for experimenting with cross-institutional data interoperability. Provincial and district health offices rely on nutrition surveillance reporting through SSGI, while the *e-PPGBM* platform records individualized data (*by name by address*) via community-based *posyandu*. At the national tier, SIGIZI aspires to function as the integrative hub, yet frequently suffers from desynchronization with local datasets. Simultaneously, the emergence of locally tailored applications such as *Semampai* in Mataram or *Bakso* and *Keris* in East Lombok demonstrates decentralist innovation but paradoxically intensifies integration complexity, owing to the absence of uniform data standards and indicator taxonomies. Consequently, rather than materializing as a genuinely federated data architecture, the system resembles a patchwork arrangement of digital silos: loosely coupled, semantically inconsistent, and structurally inadequate for big-data driven predictive analytics.

The following matrix maps the constellation of health information systems and cross-sectoral applications in NTB, outlining their institutional anchorage, functional contribution, integration barriers, and potential trajectories toward federated systems and big data harmonization:

Table 2. Cross-Institutional Health Data Integration in West Nusa Tenggara Province

System Component	Institution / Platform	Core Function	Challenges	Potential for Federated System & Big Data Harmonization
<i>e-PPGBM (NTB)</i>	NTB Provincial Health Office, Community Health Centers (<i>Puskesmas</i>), Family <i>Posyandu</i>	Recording child nutritional status at <i>posyandu</i> sites	Input bias, limited measurement tools, insufficient human resources	Community-level granular data serving as integrative input to <i>SIGIZI</i>
<i>Local SIGIZI</i>	District/Municipal Health Offices	Regional nutrition data integration	Indicator discrepancies across districts, weak synchronization	Middleware facilitating convergence toward the national <i>SIGIZI</i> system
<i>Local Apps (Semampai, Keris, Bakso, etc.)</i>	District/Municipal Governments in NTB	Innovative local stunting monitoring and data logging	Non-standardized data formats, lack of linkage to national platforms	Potential nodes within a federated data ecosystem
<i>100% Family Posyandu Initiative</i>	NTB Provincial Government	Expanding family-based health data coverage	Limited digital literacy among cadres, manual data entry	Crucial contribution to a real-time early warning system
<i>BKKBN–NTB Collaboration</i>	Provincial BKKBN Office	Integration of at-risk family data	Duplication with Ministry of Health nutrition datasets	Context-sensitive family-based dataset enriching big data harmonization
<i>NTB Zero Stunting Dashboard</i>	NTB Provincial Government	Monitoring performance toward <i>Zero Stunting</i> targets	Dependence on synchronization with district-level applications	AI-enhanced dashboard enabling predictive hotspot analysis

Source: Command Center/Regional Technical Implementation Unit for Digital Service Center, Department of Communication, Informatics, and Statistics of West Nusa Tenggara Province.

The quality of cross-sectoral data integration in West Nusa Tenggara (NTB) can be conceptualized as an epistemic stratification in which bureaucratic, technological, and community layers operate within distinct domains of meaning. At the bureaucratic level, health data is regarded as an administrative artifact underpinning the legitimacy of governmental programs. At the technological level, data functions as a digital entity processed through algorithms, dashboards, and harmonization pipelines. At the community level, however, child growth and nutritional data represent a social narrative that documents familial experiences of deprivation, caregiving patterns, and sanitation conditions. In the absence of semantic interoperability that bridges these strata, big data harmonization risks

degenerating into mere numerical normalization rather than structural interpretation. This underscores the urgency of ontology-based harmonization: aligning heterogeneous terminologies, codifications, and nutritional indicators into a national ontology that allows health data to be understood not only as statistical input but as a representation of NTB's profoundly diverse socio-cultural realities.

The federated system capacity demanded by NTB's realities transcends technical database integration, implicating instead the politics of data. Within a federation, every local node whether a *puskesmas* in West Lombok, a family *posyandu* in Dompu, or a municipal digital platform in Mataram retains epistemic autonomy in managing its own data while remaining bound to national interoperability protocols. This paradigm fundamentally challenges the bureaucratic logic that centralizes data authority within ministries. Put differently, a federated system in NTB presupposes a redistribution of data power from the center to the periphery, thereby transforming data politics into a contested arena between national and local actors. Without such political awareness, stunting data integration will remain entrapped within bureaucratic hierarchy's incapable of responding to local dynamics.

Within the horizon of big data, harmonizing stunting information in NTB necessitates a more profound epistemic transformation: data must be conceived as a *living artifact*, migrating across mediums from manual records in *posyandu*, to digital application inputs, to public health-related searches on Google Trends. The fact that public search trends on stunting do not always correspond with official epidemiological data underscores an epistemic gap between digital awareness and formal surveillance. Big data harmonization must therefore transcend technical integration, advancing toward hermeneutic integration capable of bridging infodemiology (societal digital behavior) with clinical data (anthropometry and nutrition). Absent this, digital systems risk reinforcing rather than dismantling the divide between technocratic representations and lived social experiences.

Equally critical is the variable of local digital literacy in shaping integration effectiveness. Empirical studies from Surabaya and Sragen, which bear relevance to NTB, indicate that low levels of digital literacy among community cadres and households result in biased, incomplete, or even manipulated data inputs. This directly undermines big data harmonization, for predictive algorithms remain only as robust as the data they ingest *garbage in, garbage out*. In NTB, the expansion of the *100% Family Posyandu* initiative has broadened the scope of nutrition data collection yet has not automatically enhanced input quality due to persistent constraints in measurement standardization, cadre skills, and input motivation. Thus, interoperability rests not only on technological devices but equally on the digital literacy capacity of human actors operating the system.

The stunting crisis in NTB exposes the dynamics of digital biopolitics: child data is not merely a prevalence statistic, but a digital body negotiated by multiple actors. For health authorities, data signifies programmatic legitimacy; for local governments, a performance indicator; for digital applications, an innovation baseline; and for families, a personal record of survival. Within this frame, cross-sectoral interoperability constitutes a field of power that determines whether the digital body of NTB's children is construed as an object of bureaucratic control or as a subject empowered through technology. Big data harmonization gains meaning only insofar as it redistributes power equitably rather than reproducing new forms of exclusion.

Amidst these dynamics, the opportunity for integrative technology governance in NTB remains open through strategies of ecosystemic governance that prioritize data sovereignty, cross-sectoral accountability, and interoperability openness. Such a model necessitates collaboration among local governments, application developers, academic institutions, and user communities in defining data standards, harmonization pipelines, and predictive dashboards. If managed seriously, cross-sectoral integration in NTB could generate machine-learning-based predictive analytics capable of identifying stunting hotspots in coastal settlements or sanitation-poor villages. Yet, without equitable ecosystem construction, technology risks reproducing inequality and entrenching centralistic logics.

A further fundamental challenge lies in the absence of an ethical regulatory framework safeguarding digital health data security and privacy. As global practice illustrates, even advanced regimes such as the European Union's GDPR wrestle with tensions between data protection principles and technological expansion. In NTB, regulatory weakness heightens risks of child and family data leakage, especially given the proliferation of local applications lacking data protection officers or audit mechanisms. This regulatory fragmentation corrodes public trust in digital systems, in turn reducing community participation in data input. Cross-sectoral interoperability without ethical foundations merely accelerates fragmentation rather than fostering integration.

Analysis of NTB's data integration practices also reveals the problem to be not only technical but epistemological: data continues to be produced within sectoral rather than ecosystemic logics. The health office curates nutrition data, the BKKBN manages family data, the gender office (P3AP2KB) holds gender-related data, while the education system retains records of school-based nutrition literacy interventions. Without federated mechanisms, such datasets remain fragmented despite digitization. True interoperability demands a paradigmatic shift from technicist integration to hermeneutic integration, wherein each dataset is read relationally across sectors. For example, stunting prevalence in East Lombok cannot be explained through nutritional data alone but requires contextualization with sanitation, poverty, and caregiving practices.

The survival opportunities of NTB's children, defined by the digital health system's capacity to rapidly detect chronic malnutrition risks, hinge on cross-sectoral data harmonization. Integration enables early detection of stunting risks at the hamlet level, allowing timely nutritional interventions. Yet, without interoperability, early detection becomes illusory, as case data remains trapped within administrative silos, delayed in escalation to provincial/national levels, and ultimately fails to shape policy responsively. Thus, the quality of NTB children's lives is contingent upon both the technological and political capacities of the health data architecture they inhabit.

Mapping these complexities, cross-sectoral data interoperability in NTB emerges as an epistemic arena that interweaves technological fragmentation, data politics, digital ethics, community literacy, and the biopolitics of health. Big data harmonization is not an endpoint but a continuous process requiring epistemic engineering, redistributive politics, and socio-cultural investment. Only through such a pathway can technological integration be transformed from administrative rhetoric into a substantive instrument of stunting mitigation.

3.2 Asymmetries in Technological Accessibility

In West Nusa Tenggara (NTB), the persistence of stunting prevalence has long reflected structural determinants rooted in socio-economic, ecological, and cultural domains, yet it is increasingly mediated by the digital divide. This divide does not merely signify infrastructural deficits but also embodies unequal digital literacy, uneven resource allocation, and asymmetric access between bureaucratic actors with policy authority, frontline health workers delivering services, and community beneficiaries who remain the targets of intervention. Such disparities have crystallized into a form of asymmetric digital governance, wherein the architecture of digital health is disproportionately monopolized by bureaucratic elites, while community users remain subordinated within the flows of information and decision-making ; .

The national intervention framework, codified in Presidential Regulation No. 72 of 2021 on the Acceleration of Stunting Reduction, underscores the strategic role of family information systems, nutrition data integration, and dashboard-based monitoring. Yet at the subnational level, as in NTB, the manifestations of digital disparity are striking. Field evidence shows that approximately 43% of health workers in rural NTB face limited access to stable internet, while over 58% of targeted families lack adequate digital devices to access application-based health services. This paradox reveals a fundamental misalignment: while national policy orients toward digitalization, local ecosystems remain structurally unprepared, both infrastructurally and in terms of literacy.

From a Digital Health Governance perspective, these conditions generate the risk of policy misalignment. Local bureaucracies equipped with digital instruments such as the NTB Stunting Dashboard or the Family Information System (*SIGA*) may routinely produce reports, yet such outputs often fail to represent ground realities due to restricted participation by frontline health workers and households. This asymmetry produces data bias, whereby reported prevalence rates may underestimate the true burden, as children in remote areas remain digitally unrecorded. Within the theoretical framework of digital governance, this constitutes data invisibility: the systemic erasure of marginalized groups within digital architectures, undermining inclusivity in policy intervention.

The *Gerakan Orang Tua Asuh Cegah Stunting (GENTING)* initiative in North Lombok, designed as a pentahelix-based social innovation, was intended to bridge policy–community gaps. Yet, its implementation encounters substantial barriers under digitalization imperatives. Application-based monitoring requires consistent data input from *posyandu* cadres, many of whom lack sufficient training in digital tools. This has produced a technological bottleneck, wherein policy innovations stagnate due to the limited operational capacity of grassroots actors.

The international framework *Digital Health Competencies in Medical Education (DECODE)* identifies four key domains: professionalism in digital health, digitalization of patient–population services, health information systems, and health data science. When contextualized within NTB, a profound competency gap becomes visible: bureaucracies demonstrate relative mastery in domains of information systems and data governance, whereas frontline health workers exhibit limited literacy in patient–population digitalization. This divide is further exacerbated by community users’ near-absence of basic digital health literacy. Consequently, cross-domain data integration fails to achieve coherence, and digital health governance consolidates as an elitist and bureaucratic project rather than an inclusive one.

Table 3. Distribution of Digital Accessibility among Actors in West Nusa Tenggara (NTB)

Actor	Stable Internet Access (%)	Digital Health Literacy (%)	Access to Health Applications (%)
Local Bureaucracy	87	78	92
Health Workforce	57	49	55
User Communities	42	31	28

Source: Command Center/Regional Technical Implementation Unit for Digital Service Center, Department of Communication, Informatics, and Statistics of West Nusa Tenggara Province.

The table illustrates the pronounced asymmetry of digital accessibility: bureaucratic actors dominate digital infrastructures, while user communities constitute the most vulnerable group within this stratified ecosystem. This asymmetry transcends technical limitations, extending into epistemological domains specifically, the legitimacy to define and problematize “stunting” within digital governance frameworks. Bureaucracies assume the role of *data holders*, health workers function as *data transmitters*, and communities remain relegated to *data subjects*. Such a constellation entrenches hierarchical power relations in which data-driven health governance disproportionately represents the interests of system managers over the lived experiences of citizens.

From a governance studies perspective, the NTB digital divide reflects *technological path dependency*, whereby adoption trajectories are conditioned by infrastructural histories and bureaucratic routines. Urban centers such as Mataram benefit from robust telecommunications infrastructures that facilitate rapid uptake of digital health applications, whereas rural areas like North Lombok, Dompu, and Sumbawa remain locked into a *low-tech equilibrium*. Consequently, stunting mitigation strategies anchored exclusively in digitalization risk producing *policy inertia* a stagnation of reform rooted in the inability to transcend inherited structural bottlenecks [45].

This asymmetry may also be interpreted through the lens of *socio-technical assemblage*, recognizing technology as an entity co-constituted with social, cultural, and political relations. In NTB, state-promoted health applications are frequently perceived as bureaucratic instruments of control rather than community-empowerment tools. This perception is substantiated by the low adoption rates: merely 28% of at-risk households actively use the Posyandu Digital application to monitor child nutrition status. Such figures demonstrate a condition of *technological alienation*; wherein ostensibly inclusive technologies generate new modalities of social distance between state apparatuses and citizens.

Another dimension of digital asymmetry is the competence gap between bureaucrats and health workers. Internal surveys reveal that only 49% of health workers feel confident operating digital health information systems, compared to 78% among bureaucrats. This disparity produces *capability asymmetry*, leading to suboptimal data input quality. Many health workers continue to rely on manual recordkeeping, with subsequent transcription into digital systems by other actors a process prone to errors, delays, and distortions. The result is compromised data integrity, undermining evidence-based policy interventions that require high-

resolution micro-level precision, such as identifying children at nutritional risk at the village level.

Within the *policy informatics* framework, effective governance depends upon seamless data integration across levels [46]. Yet NTB demonstrates acute *data governance fragmentation*: Posyandu data are managed by local health offices, family data by BKKBN, and social assistance data by social services. This fragmentation signals the absence of *interoperability governance*, resulting in burdensome duplicate data entry by health workers and the phenomenon of *data fatigue*, wherein administrative exhaustion diminishes direct medical service delivery.

Table 4. Degree of Data Fragmentation across Agencies in NTB (2024)

Data Type	Managing Agency	Primary Digital System(s)	Level of Interoperability
Child Health Data	Health Office	e-PPGBM, DHIS2	Low
Family Data	BKKBN	SIGA, GENTING Dashboard	Medium
Social Assistance Data	Social Affairs Office	SIKS-NG	Low
Child Education Data	Education Office	Dapodik	Low

Source: Command Center/Regional Technical Implementation Unit for Digital Service Center, Department of Communication, Informatics, and Statistics of West Nusa Tenggara Province.

Empirical evidence from the table highlights that asymmetry manifests not only among actors but also across digital systems. Fragmentation undermines inclusivity of stunting interventions: for instance, a child registered in BKKBN’s SIGA but absent from the Health Office’s e-PPGBM risks exclusion from nutritional assistance, as distribution systems rely on cross-validation mechanisms. This constitutes *algorithmic exclusion*, wherein systemic non-interoperability results in denial of services. Such exclusion has profound implications for *digital health governance*, directly affecting distributive equity in health services.

Cultural factors further compound this digital divide. In rural NTB, resistance toward digital applications arises from their perceived disruption of traditional face-to-face *posyandu* practices. Manual recordkeeping is valued for its tangibility and communal resonance. This underscores the need to approach digital health governance through the prism of *cultural governance*. Absent cultural sensitivity, digital interventions risk exacerbating the disjuncture between state-led policy design and community practice, thereby diminishing program effectiveness.

The persistence of the digital divide necessitates a *multi-level governance* response [47]. At the macro level, the provincial government must orchestrate interoperable data standards. At the meso level, technical coordination mechanisms between the Health Office and BKKBN are essential to ensure data flows without compounding administrative burdens. At the micro level, *posyandu* cadres require digital literacy capacity-building to act as frontline intermediaries. Without such systemic recalibration, digital health governance risks remaining top-down, perpetuating exclusion among digitally marginalized communities.

Table 5. Comparative Levels of Digital Health Governance in NTB

Governance Level	Primary Focus	Dominant Actors	Manifest Asymmetries
Macro	Cross-agency integration	Provincial Government	Regulatory and data fragmentation
Meso	Technical application use	Health Office, BKKBN	Data duplication, administrative burden
Micro	Community-level services	Posyandu cadres, households	Low digital literacy

Source: Primary Data, 2025

This tri-level analysis elucidates the production of *triple asymmetry*: (1) between bureaucrats and health workers in technological mastery; (2) between health workers and communities in digital literacy; and (3) among digital systems in their interoperability. Collectively, these asymmetries generate governance fragmentation, data biases, and digital exclusion further entrenching structural inequalities.

While NTB has pioneered initiatives such as *Gerakan Orang Tua Asuh Cegah Stunting (GENTING)*, their transformative potential remains constrained by weak digital infrastructures. International frameworks such as DECODE emphasize the salience of *digital determinants of health* factors such as internet access, device ownership, and digital literacy which must be treated on par with classical social determinants (income, education, sanitation). Yet in NTB, digital determinants remain marginalized within stunting policy frameworks, despite evidence that children in households without internet access are 1.7 times more likely to be excluded from monitoring systems.

Ultimately, NTB’s digital health governance reveals the contours of *digitalized inequality*, wherein inherited socio-economic inequities are amplified, rather than alleviated, by the digital turn. Absent a deliberate push toward inclusivity, digital interventions risk perpetuating stunting as an intergenerational structural problem in its new form: *algorithmically mediated inequity*.

3.3 Socio-Technological Resilience in Digital Health Governance

The concept of socio-technological resilience in digital health governance underscores the capacity of an ecosystem to absorb structural shocks, adapt to constraints, and transform in the face of systemic vulnerabilities. In West Nusa Tenggara (NTB) Province, the framework of stunting mitigation has entered a new phase, wherein digital transformation functions as a strategic instrument for integrating public policy, technology, and data. Yet, digital resilience here is tested not merely by infrastructural robustness but also by the social capacity to respond to policy fragmentation and the threat of exclusion among vulnerable populations. Unlike approaches that focus solely on asymmetries of access, resilience foregrounds adaptive dynamics how bureaucratic actors, health workers, and communities strive to sustain system functionality under conditions of structural uncertainty ; .

Stunting in NTB is not simply a biological phenomenon but an intricate articulation of social, ecological, and now digital vulnerabilities. The implementation of Digital Health Governance through instruments such as the *stunting dashboard*, the Family Information System (SIGA), and the integration of GENTING is essentially an endeavor to construct collective resilience capacity. However, resilience is tested when digital systems encounter fragmented governance for example, overlapping mandates among the National Population and Family Planning Agency (BKKBN), the Health Office, and local government, coupled with uneven digital infrastructure across

regions. This incongruence generates *governance fragility*, a condition in which digital instruments that should serve as integrative binders instead expose systemic vulnerabilities due to incohesive coordination.

The international DECODE framework articulates four domains of digital health competence: professionalism, patient–population services, health information systems, and health data science. In the NTB context, resilience challenges emerge particularly in the domain of health information systems, which remain vulnerable to cross-institutional disintegration. For instance, child nutrition data stored in *e-PPGBM* often fails to synchronize with family data in SIGA, thereby producing *data silos*. Socio-technological resilience, therefore, requires the construction of *interoperability bridges* both technical and institutional mechanisms that allow disparate systems to exchange information securely. Without such mechanisms, digital systems will continue to exhibit *fragmented resilience*, in which adaptation occurs only in partial and localized ways rather than systemically.

Table 6. Indicators of Fragmentation in Digital Health Governance in NTB (2024)

Dimension	Empirical Indicator	Vulnerability Level (%)
Policy	Overlapping regulations across institutions	64
Infrastructure	Limited internet coverage in rural areas	52
Data	Non-synchronization between <i>e-PPGBM</i> and SIGA	47
Human Resources	Community health cadres without digital training	58
Institutional	Weak coordination in the pentahelix framework	42

Source: Compilation of Official Government Documents of West Nusa Tenggara, 2024–2025

The table demonstrates that the highest vulnerability lies in human resource capacity (58%), revealing the system’s weak *absorptive capacity*. Community health cadres and frontline workers actors who should uphold the system’s foundation become the weakest link due to insufficient digital training. This underscores that socio-technological resilience is not solely an infrastructural function but also a cognitive, affective, and social capacity of actors. Without strengthening grassroots-level digital competence, NTB’s digital resilience remains fragile despite seemingly advanced central infrastructures.

Hybrid adaptation strategies emerge in response to infrastructural deficits. Some villages combine manual record-keeping with *delayed digital entry*, whereby data is first noted on paper and later entered into applications once internet access becomes available. While this represents *adaptive resilience*, it simultaneously introduces risks of *data lag*, thereby reducing the accuracy of evidence-based policymaking. Such improvisational resilience is short-term and cannot substitute for long-term structural investment in rural digital infrastructure.

Table 7. Risks of Social Exclusion in NTB’s Digital Health System (2024)

Vulnerable Group	Percentage Unregistered in Digital Systems (%)	Potential Impact
Rural poor households	39	No access to nutrition interventions
Children <2 years in remote villages	26	Omitted from growth monitoring
Pregnant women without devices	33	Excluded from digital nutrition counseling
Persons with disabilities	22	Limited access to telehealth services

Source: BPS West Nusa Tenggara, NTB in Figures 2024

The table illustrates that digital exclusion is most pronounced among rural poor households (39%) ironically, the very group at highest risk of stunting. This suggests that resilience remains *selective*, privileging groups with technological access while leaving vulnerable populations doubly marginalized.

Institutional fragility further exacerbates these exclusions. Initiatives such as GENTING highlight collaborative capacities within a pentahelix model yet remain hindered by fragmented institutional logics and non-integrated digital systems. This condition manifests as *institutional brittleness* an inability of institutional resilience to reinforce technological resilience.

Table 8. Resilience Capacities of NTB's Digital Health System (2024)

Resilience Dimension	Key Indicator	Capacity Score (1–5)
Infrastructure	Stability of networks and devices	2.8
Institutional	Cross-institutional coordination	2.5
Human Resources (HR)	Training and digital literacy of health staff	2.7
Adaptive Technology	Offline entry and system integration	3.1
Feedback Loop	Speed of community-level data response	2.4

Source: Command Center/Regional Technical Implementation Unit for Digital Service Center, Department of Communication, Informatics, and Statistics of West Nusa Tenggara Province.

From the table, it is evident that the highest capacity score lies in adaptive technology (3.1), reflecting local innovations aimed at navigating structural limitations. Conversely, the lowest score is observed in the feedback loop dimension (2.4), signaling the system's weak capacity to generate direct benefits for the population. Thus, while the system demonstrates the ability to “survive” through technical adaptation, its resilience remains defensive rather than transformative. At present, digital resilience in West Nusa Tenggara (NTB) can be classified as a form of *low equilibrium resilience*: the system endures under constraints but fails to leap toward a truly inclusive and responsive governance model.

Equally critical is the need to examine socio-technological resilience through the lens of data politics. Digital health systems serve not merely as technical instruments but also as political arenas, wherein data functions as a commodity of policy legitimacy. In NTB, bureaucratic actors tend to instrumentalize the stunting

dashboard primarily as a legitimizing device for reporting achievements rather than as a platform for dialogue with communities. Resilience, in this context, is tested by the extent to which the digital system can balance political imperatives with social needs. Yet, when the dominance of data politics becomes overwhelming, the system tends to exhibit *performative resilience*: seemingly robust on the surface (through polished reports) but substantively fragile, as it fails to address the structural roots of stunting.

Furthermore, socio-technological resilience encompasses the distribution of risks. Resilience theory posits that risks should not be concentrated within a single actor but distributed across the system to ensure survival even when one element fails [48]. In NTB, however, the burden of digital risks is disproportionately placed upon health workers. They are simultaneously expected to guarantee accurate data input, deliver counseling, and serve as digital literacy mediators for communities. This concentration of risk produces a form of *resilience overload*, wherein health workers experience role fatigue that diminishes the system’s overall adaptive capacity. In other words, the digital system’s endurance is structurally fragile because it disproportionately relies on actors with the most limited resources.

Table 9. Risk Distribution in NTB’s Digital Health System (2024)

Actor	Risk Burden (%)	Implications for Resilience
Regional Bureaucracy	21	Oriented toward political legitimacy
Health Workers	49	Role overload, compromised data quality
Community Health Cadres	18	Dependency on limited grassroots capacities
End-User Communities	12	Digital exclusion, low participation

Source: National Population and Family Planning Board (BKKBN), West Nusa Tenggara Province

This table reveals a marked imbalance in the distribution of systemic risk: nearly half of the burden of the digital health system falls upon frontline health workers. Such a concentration undermines resilience by creating a single point of failure; if health workers fail to adapt, the integrity of the entire system is compromised. The concept of socio-technological resilience necessitates a redistribution of risks through an authentic pentahelix mechanism: the bureaucracy should assume responsibility for data coordination, the private sector should provide infrastructural support, academia should strengthen analytical capacity, and communities should enhance participatory engagement. Absent such redistribution, NTB’s digital health system remains trapped in a state of stress-dependent resilience robust only insofar as key actors do not succumb to fatigue.

Equally critical is the dimension of normative resilience, defined as the system’s capacity to remain aligned with principles of social justice. Digital exclusion of marginalized groups such as low-income households, pregnant women without access to mobile devices, and persons with disabilities constitutes a violation of health equity. A truly resilient system is not merely one that endures, but one that guarantees fairness in access. Yet in NTB, digital resilience remains skewed toward technologically privileged groups. This has produced a form of stratified resilience: those with superior access demonstrate greater resilience to stunting, whereas excluded groups remain structurally vulnerable.

Socio-technological resilience must also be interrogated through a long-term temporal lens. NTB’s digital health system currently inhabits an incipient stage of transformation ; . The critical question is whether it can evolve into transformative resilience or remain confined to reactive resilience. Transformative indicators include efforts to build inter-system integration, investments in sustainable infrastructure, and community empowerment through digital literacy. Should these dimensions be strengthened, NTB holds the potential to emerge as a model of regional resilience. However, if reliance continues localized improvisation alone, the system risks entrapment in a cycle of short-term adaptive responses that ultimately exhaust its capacity.

Table 10. Spectrum of Socio-Technological Resilience in NTB (2024)

Resilience Type	Key Characteristics	NTB Status (2024)
Reactive Resilience	Survival through localized improvisation	Dominant
Adaptive Resilience	Hybrid manual–digital solutions	Partial
Transformative Resilience	Fully integrated, inclusive, sustainable	Not yet achieved

Source: NTB resilience assessment

Overall, NTB’s digital health governance embodies resilience under constraint: the system adapts through improvisation but remains structurally fragile, exclusionary, and bureaucratically fragmented. Without structural transformation toward full interoperability, equitable access, and redistributed governance risks, digital resilience will remain defensive and temporary mitigating stunting in the short term but perpetuating digitalized inequality across generations.

3.4 Digital–Bureaucratic Power Relations Dynamics

Within the horizon of digital governance studies, the dynamics of power relations among health bureaucracies, technology developers, and beneficiary communities constitute an epistemic determinant rarely addressed explicitly, despite their direct implications for stunting mitigation effectiveness. In West Nusa Tenggara (NTB), digital health transformation is not merely a technical innovation but a hegemonic arena in which bureaucratic authorities consolidate political legitimacy through data and algorithms. This phenomenon may be conceptualized as *digital biopolitics*, where the stunted child’s body is reduced to a *datafied subject*, its existence defined by processes of recording, verification, and interpretation within bureaucratically dominated digital infrastructures.

The health bureaucracy in NTB emerges as a hegemonic actor, controlling both regulatory and epistemic infrastructures, such that stunting mitigation policies tend to reflect institutional imperatives rather than community needs. This dynamic is evident in the practice of *dashboardization*, where success is measured through numeric target achievements reported upwards, rather than through substantive social transformation experienced by communities. By rendering digital data as a *currency of legitimacy*, the bureaucracy effectively dominates mitigation narratives, relegating technology developers and community users into subordinate positions. Such a constellation embodies what can be termed *digital–bureaucratic authoritarianism*, concealed beneath the rhetoric of inclusivity.

Technology developers, whether from private or academic sectors, operate within the bureaucratically constructed sphere of power. They lack full autonomy to innovate and must conform to the rigid regulatory logic of bureaucracy. Innovations such as *Posyandu Digital* applications or AI-based monitoring systems are compelled into alignment with administrative reporting standards that privilege format uniformity over contextual accuracy. This process exemplifies *algorithmic domestication*, whereby technology is tamed to serve bureaucratic representational needs rather than to amplify community voices.

Table 11. Distribution of Power Relations in NTB's Digital Health Governance Ecosystem (2024)

Actor	Primary Source of Power	Autonomy Space (%)	Degree of Dominance (%)
Health Bureaucracy	Regulation, budget allocation, data	25	62
Technology Developers	Technical innovation, academic support	41	23
Beneficiary Communities	Experiential knowledge, participation	34	15

Source: Government of West Nusa Tenggara – Regional Development Work Plan (RKP) Document

The table reveals that bureaucratic dominance (62%) significantly outweighs that of other actors, despite technology developers possessing greater innovative autonomy (41%). This asymmetry produces structural lock-in: technical innovation cannot be implemented freely due to *bureaucratic gatekeeping*. Beneficiary communities, with only 15% dominance, remain marginal in shaping policy directions, reflecting a profound *participatory deficit*, where claims of digital inclusion mask deliberative exclusion.

From the vantage of *policy assemblage*, bureaucracy functions not merely as an administrative actor but as a *policy curator*, deciding which technologies are adopted, how data are collected, and what narratives are disseminated. By monopolizing policy logistics, bureaucracy sets the agenda, affirming its role as *sovereign of digital discourse*. Consequently, even advanced innovations (AI, predictive analytics) are only accepted insofar as they conform to bureaucratic reporting regimes.

For beneficiary communities, this dynamic generates *digital alienation*. Many low-income households in NTB report exclusionary experiences, as health applications cater primarily to bureaucratic reporting needs rather than user needs. Applications demand numerical inputs on nutritional status but neglect spaces for narrative accounts of maternal or child experiences. Communities thus become *data suppliers* rather than *policy co-creators*. This erosion of trust undermines social legitimacy for digital interventions.

Table 12. Community Perceptions of NTB's Digital Health Interventions (Survey 2024)

Perception Indicator	Agree (%)	Disagree (%)
Application beneficial for families	37	63
Application benefits bureaucracy	72	28

Perception Indicator	Agree (%)	Disagree (%)
more		
Input data has direct impact	29	71
Community participation is facilitated	22	78

Source: Results of a Survey Conducted by the National Population and Family Planning Board (BKKBN), West Nusa Tenggara Province

The survey underscores significant dissatisfaction: 72% of respondents perceive applications as primarily serving bureaucratic interests, while only 22% feel their participation is genuinely facilitated. This exposes digital inclusion paradox governmental claims of participation belie community perceptions of exclusion. In the long run, such dissonance erodes the *trust infrastructure* essential for public health governance.

Budgetary allocation further illustrates bureaucratic dominance. Analysis of NTB's 2024 digital health budget shows over 68% directed to hardware procurement and consultancy contracts, while only 21% supports health worker training and 11% community literacy programs. This imbalance exemplifies *capital-intensive governance*, privileging material accumulation over social empowerment. Bureaucracy thus reproduces dominance through resource allocation as much as through regulation.

Table 13. NTB Digital Health Budget Allocation (2024)

Component	Budget Share (%)
Infrastructure & hardware	68
Health worker training	21
Community digital literacy	11

Source: Work Plan and Budget (Renja / RKPD / RKA) Document of the Health Office, 2024

Within an *actor-network theory* (ANT) framework, such dynamics emerge from hybrid configurations of human and non-human actors. Bureaucracy deploys regulations, devices, and algorithms as *actants* that extend its authority ; ; ; . Technology developers are reduced to *technical subcontractors*, while communities become *inscribed entities* governed by standardized data inputs. This reveals how bureaucratic dominance stems not only from formal structures but also from the mobilization of *material-semiotic networks*.

Budget asymmetries also produce *policy opacity*. Decisions on platform selection, vendor engagement, and success indicators occur in closed circuits, excluding community deliberation. This opacity widens the epistemic gap between bureaucrats and communities, reconfiguring digital health governance as an instrument of control rather than empowerment.

From a *critical data studies* perspective, bureaucratic dominance reflects *data colonialism*: community data are extracted, exploited, and showcased for bureaucratic legitimacy without reciprocal benefit. For instance, NTB's stunting dashboard privileges macro-statistics for political display, yet fails to provide granular insights meaningful to households or *posyandu*.

The consolidation of bureaucratic power yields *technocratic capture*, subordinating innovation and social participation to bureaucratic agendas. Digital health governance's potential for democratization is thus obstructed, supplanted by a

centralist logic of control. Nevertheless, resistance exists: some *posyandu* cadres maintain manual records, delaying digital entry as quiet defiance against bureaucratic burdens, while developers occasionally embed non-formal user-friendly features despite bureaucratic disapproval. These practices constitute *hidden transcripts of resistance*, underscoring that digital–bureaucratic power relations are dynamic rather than absolute.

The implications are profound. NTB’s stunting prevalence shows fluctuation: 32.7% (2022), 24.6% (2023), 25.9% (2024), and 28% (2025). Such instability indicates that bureaucratic dominance focused on reporting and legitimacy fails to sustain consistent reductions. This validates the thesis that power relations, not merely technology, determine intervention efficacy. In conclusion, the dynamics of digital–bureaucratic power relations in NTB reveal a pattern: bureaucracy controls regulatory, financial, and epistemic domains; technology developers remain subordinated; and beneficiary communities are marginalized from deliberative arenas. Stunting mitigation thus resembles a technocratic project rather than an inclusive social movement.

5. Conclusions

The findings of this study affirm that Digital Health Governance in the framework of stunting prevalence mitigation is not merely a matter of technological adoption, but rather a complex epistemological configuration in which cross-sectoral data interoperability, asymmetries of technological accessibility, socio-technological resilience, and the dynamics of digital–bureaucratic power relations operate as mutually entangled structural determinants. Data interoperability reveals a paradox of integration: instead of materializing as a harmonized *federated system*, practices in West Nusa Tenggara (NTB) tend to reproduce a fragmented *patchwork architecture*, whereby *big data* functions less as an evidence-based predictive instrument and more as a vehicle of bureaucratic legitimation. The asymmetry of technological access exposes the digital divide among bureaucracies, health workers, and community users, engendering algorithmic exclusion of marginalized and remote populations, while simultaneously reinforcing digitalized inequality as a novel form of structural violence. Meanwhile, socio-technological resilience sustained by local improvisations and hybrid manual–digital strategies remain at an adaptive–reactive level. Although such arrangements enable program continuity, the system remains fragile with respect to inclusivity, risk distribution, and institutional integration. Within the dimension of power relations, bureaucracy emerges as the sovereign of digital discourse, monopolizing data, algorithms, and budgets, while technology developers and beneficiary communities remain confined to instrumental subordination. This condition perpetuates a participatory deficit, progressively eroding the trust infrastructure essential for collective health governance.

Taken together, these findings underscore that stunting mitigation through digital health governance necessitates structural transformation beyond digital technocratism: constructing semantic interoperability through federated data architectures; reducing access asymmetries via investments in literacy and infrastructure; strengthening resilience by redistributing risks within a *pentahelix* framework; and democratizing power relations so that technology may function as an instrument of collective empowerment rather than a mere bureaucratic apparatus of control.

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