



Sustainable Construction of Smart Elderly Care Platforms in Less Developed Ethnic Regions: Practical Logic and Feasible Pathways from Puge County, China

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Abstract. Ensuring the sustainable construction of smart elderly care platforms in ethnic minority regions remains challenging due to severe fiscal limitations, low digital literacy, and cultural heterogeneity. This paper investigates the sustainable development process of the Smart Civil Affairs Comprehensive Service Platform in Puge County, Sichuan Province, tracing its trajectory from initial planning through active operation based on public data. Drawing on public value creation theory, the analysis reveals a practical logic relying on fiscal bricolage through general-purpose bonds, proxy-mediated technical adaptations, the integration of administrative and clan networks, and the physical aggregation of data to bypass standardization conflicts. The study further identifies critical vulnerabilities threatening long-term sustainability, including abrupt operational funding shortfalls, persistent data incompatibility, and the fragility of the proxy mechanism. To address these challenges, an ecology-centered pathway is proposed encompassing financial, service, technical, and collaborative governance dimensions. Ultimately, this research provides empirical evidence and a sustainability-oriented framework for adapting digital technologies to rural social structures in resource-constrained ethnic regions.

Keywords: smart elderly care, ethnic minority regions, public value creation, ecological governance, sustainable construction

1 Introduction

Population aging has exposed the limits of conventional care and accelerated smart elderly care platforms [16]. Using the Internet of Things, big data, artificial intelligence, cloud computing and 5G, these platforms support daily care, health management and safety protection [4][6][7]. In China, people aged 60 and above accounted for 21.8% of the population in 2023, and national policy now promotes three-tier urban-rural service networks and county-level integrated platforms. Yet ethnic minority regions lag behind eastern areas because their fiscal, infrastructural and human-resource foundations remain weak.

Puge County in Liangshan Yi Autonomous Prefecture exemplifies these constraints. Its fiscal self-sufficiency rate remains below 10%, fewer than 15% of rural older adults can use smartphones independently, and language and cultural differences complicate standardized digital services. Labor migration further weakens family support: older adults constitute nearly 40% of permanent rural residents, many of whom live alone.

This paper studies Puge County's Smart Civil Affairs Comprehensive Service Platform and analyzes its funding arrangement, technical design, daily operation and data management. It also draws comparisons with the C-Life model developed by Shenzhen H&T. The research focuses on two key issues. How do local authorities build smart elderly care platforms under severe resource shortages in ethnic minority areas? What effective approaches can be copied and promoted? Based on public value creation theory, this paper puts forward an ecological and multi-dimensional development path. The conclusions offer practical guidance for sustainable grassroots digital governance in similar regions.

2 Literature Review and Theoretical Framework

Smart elderly care combines the Internet of Things, cloud computing and big data to coordinate health monitoring, demand allocation and multi-actor services [18]. As these platforms expand to rural areas, research increasingly examines how public value, proxy participation and institutional embeddedness can address financial scarcity, weak digital capabilities and cultural diversity.

Research has shifted from technical architecture to public value, emphasizing stakeholder coordination and safeguards against inappropriate technology use [8]. Standardized systems often mismatch local needs [11], particularly where fiscal capacity is weak [17]. Proxy use allows trusted intermediaries to bridge older adults' access and skills gaps [9][10][14], but dependence and trust risks remain [2][15]. In depopulated villages, formal proxies such as grid administrators and village cadres are therefore essential.

Institutional bricolage explains how resource-poor counties reorganize limited resources to secure projects [1], while social embeddedness shows how clan networks can lower implementation costs [3][5]. Existing work nevertheless concentrates on developed regions, treats proxy use mainly as family support, and rarely integrates resource mobilization, technical adaptation, social organization and data governance in one framework.

This paper adopts public value creation theory to fill the above research gaps [12]. The theory holds that public management aims to deliver accessible, fair and sustainable public value. It covers three interrelated parts including the authorizing environment, operational capabilities and public value outcomes [13]. When applied to the case of Puge County, the authorizing environment mainly covers fund compliance and policy support. Operational capabilities involve technical solutions, grassroots mobilization and data integration. Public value outcomes are reflected in service accessibility,

basic protection and long-term operation. This theoretical framework effectively analyzes the practical logic of smart elderly care from financial, technical, organizational and data perspectives.

3 Overview, Model Comparison and Practical Logic of the Platform Construction

3.1 Overview of the Smart Elderly Care Platform Construction in Puge County

Puge County's Smart Civil Affairs Comprehensive Service Platform adapts digital elderly care to fiscal scarcity, low digital literacy and Yi cultural conditions. Led by the county Civil Affairs Bureau, the roughly RMB 30 million platform covers 13 townships and targets rural residents aged 60 and above, who account for nearly 40% of the rural population.

Project Packaging and Fundraising. Administrators combined elderly care, assistance to vulnerable groups, child welfare and disability subsidies on one platform, aligning the project with rural revitalization, aging governance and digital-government policy. Packaging IoT hardware, software, command-center renovation and mobile terminals as public infrastructure raised the project to the threshold for local government bond financing.

With fiscal self-sufficiency below 10%, Puge County could not self-finance the project. Its public-welfare orientation deterred private capital, while the absence of project revenue ruled out special-purpose bonds. General-purpose bonds therefore financed one-time construction; annual budgets and superior transfers cover cloud, network, maintenance and grid-worker costs. Separating capital and recurrent expenditure also limits audit risk.

Technical Architecture: Proxy-Use and Zero-Interaction Design. A powerful backend and lightweight frontend shift digital tasks away from older users. The county command center processes data, allocates work orders and manages warnings; passive NB-IoT devices require no user configuration. Grid workers receive alerts, visit households, assess needs, coordinate assistance and upload records, enabling older residents to access services without operating the platform.

The platform operates well thanks to the combination of administrative teams and traditional Yi kinship groups. Tasks are preferentially assigned to reputable bilingual Yi residents. A special contact list for kinship members also helps with identity verification and household access. The digital framework streamlines task distribution, and local kinship ties create mutual trust to support daily community work.

Data Governance: Physical Aggregation and Progressive Integration. The command center pools public-security, civil-affairs, disability and health data in one database. Because departmental definitions remain inconsistent, staff manually verify conflicts rather than forcing premature logical integration. Service continuity takes precedence over complete automation.

3.2 East–West Comparison: Puge County versus Shenzhen H&T C-LIFE

Table 1 contrasts Puge County's dual-network model with Shenzhen H&T's commercial C-LIFE model across funding, technology, organization, data and value. Both use IoT and data technologies, but Puge prioritizes inclusive basic protection under resource scarcity, whereas C-LIFE emphasizes efficiency, advanced technology and commercial sustainability. The comparison demonstrates that smart-care models must fit local fiscal capacity, infrastructure, social structure and governance goals.

Table 1. Comparative Analysis of the Puge County Dual-Network Integration Model and the Shenzhen H&T C-Life Model.

Comparison Dimension	Puge County Dual-Network Integration Model (Less Developed Ethnic Regions)	Shenzhen H&T C-LIFE Model (Developed Regions)
Funding Logic	Government-led & public welfare; funded via general bonds and superior transfer payments; strict separation of construction and operational costs.	Enterprise-led & commercial closed loop; funded via technology product sales, platform service fees, and commercial partnerships for self-sustaining revenue.
Technical Logic	Proxy-use & zero-interaction; "heavy backend, lightweight frontend" with passive IoT devices; elderly require no digital operation.	End-user direct engagement; centered on smart wearables, AI interactive screens, and user APPs; algorithm-driven active warning.
Organizational Logic	Administrative grids embedded in clan (jiazi) networks; work orders executed by bilingual local grid personnel to leverage acquaintance trust.	Market contracts & professional institutions; standardized service delivery via commercial care teams and community service centers.
Data Governance	Physical aggregation & pragmatic governance; multi-departmental data pooling with manual secondary verification to bypass standard conflicts.	Deep integration & intelligent computing; unified data standards for cross-departmental modeling and automated decision-making.
Value Orientation	Public value prioritizes: service accessibility, equitable basic protection, and bottom-line security over technical efficiency.	Efficiency and commercial sustainability prioritize: precision services, algorithmic optimization, and commercial value-added.

3.3 Four Practical Logics

The Puge County implementation has produced a coherent set of mutually reinforcing operating logics that collectively enable effective platform operation in underdeveloped ethnic regions.

Funding Logic: Institutional Restructuring for Compliant Bond Utilization. Faced with strict revenue requirements that made special-purpose bonds unavailable, local officials restructured a single-function elderly care project into a broader public welfare initiative. This adjustment helped meet structural debt thresholds and obtain approval

for general-purpose bonds. It also shows how institutional bricolage can work around rigid resource constraints.

Technical Logic: Proxy-Mediated Service Delivery. The system abandons the traditional user-empowering ethos in favor of human-mediated service. By shifting the digital burden onto institutional field workers, it bridges the digital divide through proxy intervention under a framework of technological humility.

Organizational Logic: Dual-Network Integration. Recognizing that algorithmic tasks lack organic social traction, Puge County embedded administrative commands within customary Yi kinship networks. This fusion transforms digital work orders into trusted, personalized social responses, reducing governance friction and execution costs.

Data Logic: Pragmatic Governance Under Physical Aggregation. Rather than enforcing total backend harmonization, local authorities accepted physical data aggregation and deployed manual fault-tolerant review loops, preventing flawed institutional data definitions from paralyzing critical frontline services and embodying a practical, progressive approach suited to weak data foundations.

4 Diagnosis of Underlying Vulnerabilities and Sustainable Pathways

Puge County's model faces four long-term risks. As Fig. 1 and Table 2 show, sustainable development requires an integrated ecology of finance, services, technology and data, and collaborative governance rather than isolated technical projects.

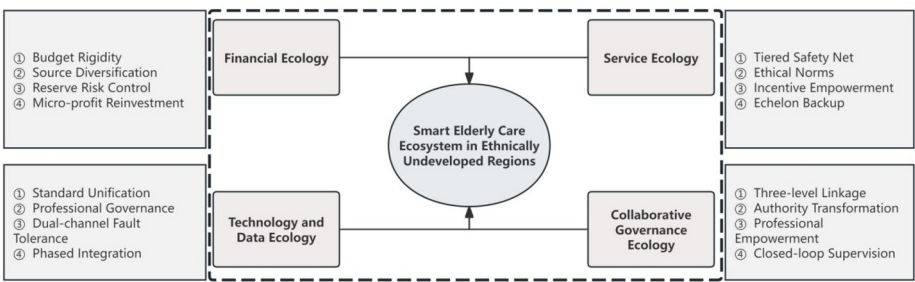


Fig. 1. Smart Elderly Care Ecosystem in Less Developed Ethnic Region

Operational Funding Precipice and Financial Ecology. One-time bonds do not cover recurring cloud, network, maintenance and personnel costs. Core operating expenses should enter annual livelihood budgets, fragmented subsidies should be pooled, and a

risk reserve should bridge funding gaps. A tiered model combining free basic services with low-cost value-added services can also attract social and charitable resources.

Proxy Mechanism Fragility and Service Ecology. Part-time grid administrators carry equipment, emergency and proxy duties with limited pay and career prospects, creating turnover risk. Stable delivery requires workload-based subsidies, performance recognition, pathways to professional social-work roles, and systematic training in digital operations, emergency response and data ethics.

Clan Network Attenuation and Collaborative Governance Ecology. Labor migration has weakened kinship support for some older residents. A resilient three-tier network should combine administrative grid proxies, clan contacts and neighborhood mutual-aid groups, with volunteers substituting where clan ties have eroded. Yi elders and De Gu can support explanation and mediation, while older residents should participate in quarterly evaluation linked to operator contracts.

Data Standard Conflicts and Technology-Data Ecology. Conflicting departmental definitions still require repeated manual review. Provincial authorities should unify core disability, health and hardship criteria, while counties appoint data staff to maintain error-handling rules. Partial integration and offline verification should remain available so data anomalies do not interrupt frontline services.

Table 2. Specific Paths for the Ecological Construction of Smart Elderly Care Platforms in Less Developed Ethnic Regions.

Dimension	Core Objective	Sustainable Pathways
Financial Ecology	Secure recurrent funding	Regularize core O&M costs in county budgets; pool welfare-lottery, transfer and counterpart funds; establish a transition reserve; combine free basic services with modestly priced value-added services.
Service Ecology	Protect all high-risk older adults	Use risk-tiered ledgers and paired visits; adopt a digital-proxy ethics code; link basic allowances to performance; provide Yi-Mandarin practical training; develop neighborhood mutual-aid backups where clan ties are weak.
Technology and Data Ecology	Resolve standards while maintaining service	Harmonize provincial assessment standards; appoint county data stewards; retain system matching plus manual verification; proceed from physical aggregation to field alignment and progressive integration.
Collaborative Governance Ecology	Build a resilient multi-actor network	Link grid personnel, clan liaisons and mutual-aid workers; involve clan leaders and De Gu in mediation; procure professional social-work support; connect user and village evaluations to contract renewal.

5 Conclusion

This research applies public value creation theory to study the Smart Civil Affairs Comprehensive Service Platform in Puge County. It summarizes four mutually supportive logics for developing smart elderly care under tight resource constraints. The county integrates multiple fiscal businesses to obtain approval for general-purpose bonds. It uses proxy services to address digital exclusion, and unites administrative grids with

local Yi kinship networks. Its data governance also focuses on basic data collection instead of complete logical integration.

All these elements shape a practical operation model centered on public value. The platform guarantees inclusive and sustainable care services rather than emphasizing technological advancement. This case proves that ethnic minority regions with limited resources cannot directly replicate the efficiency-focused models from eastern developed areas. The long-term development of local smart elderly care relies on adaptive governance. Relevant parties need to innovate institutional arrangements, integrate deeply with local society, and firmly secure basic care services for vulnerable elderly residents.

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