Optimizing Social Capital through Social Engineering: A Socio-Economic Development Strategy in Rural Areas

Daniel Harapan Parlindungan Simanjuntak[1], Supsiloani[2], Muhammad Iqbal[3], Zanrison Naibaho[4]

[1, 2, 3, 4]Lecturer in Anthropology Education Study Program, Faculty of Social Sciences, Universitas Negeri Medan, Medan, Indonesia

Corresponding author: danielhp@unimed.ac.id

Abstract. This study aims to develop and validate a structured social engineering model that optimizes social capital as a catalyst for socio-economic development in rural areas. The lack of a systematic approach to empowering social capital is the main background. Grounded in the social capital theory of Putnam and Bourdieu, this research proposes social engineering as an intervention strategy to enhance social relations and community participation. A qualitative case study method was employed in Bukit Lawang Village, utilizing data collection through in-depth interviews, document analysis, and participant observation. Findings indicate a 35% increase in social network density and a 42% rise in community participation in mutual cooperation post-intervention. This model effectively strengthens collective capacity through key components such as network bridging and trust-building. Policy recommendations include institutionalizing social engineering units at the village level and integrating social capital indicators into RPJMDes evaluations.

Keywords: Social Engineering, Social Capital, Rural Development, Social Networks, Norm Internalization

1. Introduction

Social capital, as articulated by Putnam [1] and Bourdieu [2], is a crucial element in driving rural development. It acts as a catalyst for collective action through the trust and networks formed within communities. In this context, social capital not only contributes to economic development but also strengthens social ties that are essential for community resilience. In the tourism sector, social capital plays a significant role in enhancing community resilience and innovation [3]. Communities with strong social networks are generally better equipped to adapt to changes and challenges, including those faced in sustainable tourism development. This indicates that investing in social capital can yield long-term benefits for rural populations.

However, rural communities in Indonesia face significant challenges related to social capital. Many areas experience social capital deficits, characterized by weak networks, low institutional trust, and fragmented norms [4]. These conditions hinder tourism growth and diminish the economic potential that could be derived from this sector. To address these challenges, social engineering—defined as deliberate interventions to reshape social structures [5], emerges as a potential solution. Although the term 'social engineering' is widely defined in the information security literature as the exploitation of a target's psychological vulnerabilities and cognitive

ICIESC 2025, September 16, Medan, Indonesia

DOI 10.4108/eai.16-9-2025.2361073

processes for malicious purposes [6], its fundamental principle, which is the creation of interventions that target human cognitive and behavioral mechanisms, remains relevant for positive developmental goals. However, many existing social engineering models prioritize urban and technological contexts [7], thereby neglecting the unique and diverse cultural ecosystems of rural areas [8].

It is essential to develop more inclusive social engineering models that take into account the specific characteristics and needs of rural communities. By understanding the local context, interventions can be designed to strengthen social networks and enhance institutional trust, which in turn will support tourism growth. Local wisdom, such as gotong royong or communal cooperation, has been empirically proven to strengthen social cohesion [5]. Nevertheless, these practices are often isolated from systematic social engineering strategies. Therefore, it is crucial to integrate local wisdom into social engineering frameworks to create more effective solutions.

The integration of social capital and local wisdom into development strategies can create a strong synergy. By leveraging the strengths of social networks and local values, rural communities can more easily overcome challenges and capitalize on opportunities within the tourism sector. In conclusion, to promote sustainable tourism growth in rural Indonesia, a holistic and inclusive approach is required. This includes strengthening social capital, implementing social engineering that considers local contexts, and integrating local wisdom into development strategies. With these measures, it is hoped that rural communities can achieve the resilience and innovation necessary to thrive in the modern era.

Prior studies have identified a significant gap in smart village research, particularly the over-reliance on technology. While digital infrastructure is essential for modern development, focusing solely on technological advancements often neglects the socio-cultural foundations that underpin community dynamics [6] [7] [8]. This oversight can lead to the implementation of solutions that are not culturally relevant or accepted by the local population, ultimately hindering the effectiveness of smart village initiatives. For instance, technology-driven projects may fail to engage community members if they do not align with local values and practices, resulting in a lack of ownership and sustainability.

Understanding the socio-cultural context is crucial for the success of smart village initiatives. Research indicates that communities with strong social ties and cultural practices are more likely to embrace technological innovations. Therefore, integrating socio-cultural elements into the planning and execution of smart village projects can enhance community engagement and ensure that technological solutions are tailored to meet local needs. By fostering a balance between technology and cultural relevance, smart villages can achieve more sustainable and impactful outcomes.

Another critical gap in current research is the fragmented integration of local wisdom into social capital interventions. Local wisdom is often discussed as a standalone asset, rather than being systematically incorporated into broader social capital frameworks [9]. This separation limits the potential of local wisdom to contribute to community resilience and cohesion. For example, practices such as gotong royong (communal cooperation) can significantly enhance social capital, but without intentional integration into development strategies, their impact remains underutilized.

To address this gap, it is essential to create frameworks that bridge local wisdom with social capital interventions. By recognizing local wisdom as a vital component of social capital, policymakers and practitioners can design more effective strategies that leverage community

strengths. This approach not only enhances social cohesion but also empowers communities to take an active role in their development. Integrating local wisdom into social capital frameworks can lead to more resilient and adaptive communities, capable of navigating the complexities of modern challenges. The third gap identified in prior studies is the contextual mismatch of urban social engineering frameworks when applied to rural settings. Urban-centric models often fail to account for the distinct social dynamics present in rural communities, leading to ineffective interventions [10]. Rural areas typically exhibit different social structures, cultural practices, and economic conditions compared to urban environments, which necessitates tailored approaches that reflect these unique characteristics.

To effectively address the needs of rural communities, it is crucial to develop context-specific social engineering frameworks. These frameworks should be informed by local social dynamics and cultural contexts, ensuring that interventions are relevant and applicable. By engaging with rural communities and understanding their specific challenges and opportunities, policymakers can create more effective strategies that foster social capital and community development.

Successful rural initiatives often demonstrate the importance of context-specific approaches. For instance, programs that have integrated local knowledge and practices into their frameworks have shown greater success in fostering community engagement and resilience [3]. By learning from these examples, future social engineering efforts can be better designed to meet the unique needs of rural populations, ultimately leading to more sustainable outcomes.

In conclusion, addressing the identified gaps in smart village research and social engineering requires a multifaceted approach. By balancing technological advancements with socio-cultural foundations, integrating local wisdom into social capital frameworks, and developing context-specific strategies, stakeholders can create more effective and sustainable rural development initiatives. These efforts will not only enhance community resilience but also empower rural populations to thrive in an increasingly complex world.

This study aims to address the identified gaps in existing literature by proposing a pioneering framework that integrates local wisdom into social engineering processes. The integration of local wisdom is essential for creating development strategies that resonate with the cultural and social dynamics of rural communities. By embedding local knowledge and practices into social engineering, the framework seeks to enhance community engagement and ownership, ultimately leading to more sustainable outcomes. This approach recognizes that local wisdom is not merely an asset but a foundational element that can drive effective social interventions.

In addition to proposing a new framework, this study demonstrates how cultural norms can accelerate the optimization of social capital in rural tourism. Cultural norms, which encompass shared values, beliefs, and practices, play a crucial role in shaping community interactions and fostering trust among members. By leveraging these cultural norms, communities can enhance their social capital, which is vital for collaborative efforts in tourism development. For instance, practices rooted in local traditions can facilitate cooperation and collective action, enabling communities to better navigate the challenges and opportunities presented by the tourism sector.

The study introduces a theoretical novelty termed "Cultural-Embedded Social Engineering," which emphasizes the importance of cultural context in social engineering frameworks. This concept posits that successful social interventions must be grounded in the cultural realities of the communities they aim to serve. By focusing on cultural embedding, the framework not only addresses the limitations of existing urban-centric models but also provides a more nuanced understanding of how social engineering can be effectively applied in rural settings. This

theoretical contribution is particularly relevant for scholars and practitioners seeking to develop context-sensitive strategies that resonate with local populations.

Social capital plays a role in Rural Resilience as outlined by Putnam and Bourdieu, social capital includes networks, norms, and trust that facilitate collective action within communities. Putnam's seminal work emphasizes the importance of social capital in fostering community engagement, while Bourdieu theorizes that social capital is a resource embedded in social structures that can be converted into economic benefits. In the rural context, social capital catalyzes community resilience, particularly during socio-economic shocks, as highlighted by Woolcock [11]. The multidimensional nature of social capital, consisting of bridging (intergroup), bonding (intragroup), and bonding (institutional), increases the adaptive capacity necessary for sustainable development.

Social Capital can be used as leverage for economic growth. Rural communities often leverage social capital to overcome resource constraints and improve their economic prospects [12]. Research by Flora show that high-trust networks significantly increase access to credit and information, which directly increase agricultural productivity [13]. However, the existence of fragmented norms can undermine collective action, particularly in villages in the global south, as noted by Chetty [14]. In Indonesia, Aritenang documents how social capital deficit, characterized by institutional distrust and sparse networks [4], impede tourism growth, corroborating Bebbington and Foo findings in Sub-Saharan Africa [15]. Jones work linking dense social networks to communities' ability to adapt quickly to market shifts suggests the strong link between social capital and tourism innovation is well established [3]. Communities that foster local trust are better positioned to implement equitable revenue-sharing models, which can reduce economic leakage in ecotourism initiatives [16]. However, over-reliance on bond capital can lead to exclusionary practices that marginalize minority groups within these communities [17]. This highlights the need for a balanced approach that combines bonding and bridging social capital to ensure inclusive development.

Identifies institutional distrust as a critical barrier to development in Indonesia [4], where historical centralization has eroded village autonomy and weakened cooperative traditions. This erosion of trust has resulted in tourism initiatives often failing when external agendas override local norms and practices. Consequently, a lack of alignment between local needs and external interventions can hinder community engagement and hinder sustainable tourism growth. Addressing these issues requires a concerted effort to rebuild trust and empower local communities, ensuring that development initiatives are culturally relevant and socially inclusive.

In our research perspective, Social Engineering can be a Solution, as defined by Wang, Zhu, Liu, & Sun (2021), involving "intentional interventions to reshape social structures" to foster community development. While many urban-centric models prioritize the adoption of digital tools and technologies [7] [8], achieving success in rural areas requires a strong alignment with the local cultural context. For example, study in developing countries [6] highlights the effectiveness of participatory design approaches, which emphasize community engagement rather than top-down mandates. This participatory framework not only increases resilience but also ensures that interventions are culturally relevant and widely accepted by communities, ultimately leading to more sustainable outcomes. However, over-reliance on Technology can be a cause of failure in smart village development. This critique of over-reliance on technology in rural development is reiterated [8], who show that a staggering 78% of studies in the smart village literature ignore the importance of socio-cultural foundations. This technological

optimism can lead to significant failures, as digital platforms often fail due to a lack of pre-existing trust within communities [18]. A notable example is the setback experienced by the "Digital Village" initiative in India, where a lack of local engagement and trust resulted in disappointing results [19].

This highlights the critical need for a balanced approach that integrates technology with an understanding of local social dynamics. This study looks at the untapped potential of Indigenous Knowledge in village development. Indigenous knowledge, exemplified by concepts such as mutual cooperation and politeness, is a form of communal capital that is often overlooked in development policies [20]. Research by Zuriah suggests that integrating these cultural norms into educational frameworks can significantly enhance social cohesion within communities [5]. However, despite its potential, development policies often treat indigenous knowledge as mere folklore, rather than as a vital engineering driver of social change [21]. Recognizing and leveraging this local wisdom can empower communities and increase their capacity for self-governance and resilience. Despite the recognized importance of local wisdom, there are still significant gaps in its integration into the broader social capital framework. Augmented reality (AR) illustrate how technologies can enhance cultural learning experiences but often overlook the critical role of community networks in this process [9]. This gap is further evident in UNESCO heritage tourism models, which often fail to incorporate local social dynamics into their frameworks [22]. Addressing this fragmented integration is critical to developing holistic strategies that leverage both technological advances and local cultural assets, ultimately driving more inclusive and sustainable development.

On the other hand, there is a contextual mismatch in the Urban Model. Highlighted a critical issue in the application of the urban social engineering model, noting that this framework often fails in rural areas due to different social and cultural dynamics [10]. For example, Vietnam's communal land tradition presents significant barriers to the implementation of the individualistic tourism model, which is usually favored in urban settings [23]. This mismatch underscores the need for development strategies that are sensitive to local customs and practices, rather than imposing external frameworks that may not be appropriate for rural communities. We recognize that recognizing and addressing these contextual differences is critical to fostering effective and sustainable development in rural areas.

In response to the challenges posed by contextual mismatch, this study proposes a new synthesis that integrates local wisdom into the social engineering process. This article is our attempt to bridge the gap through a Culturally Embedded approach.

Theory of "cognitive social capital" supports the idea that embedding cultural norms into interventions can increase the effectiveness and acceptance of those norms within communities [24]. In Indonesia, customary (customary) systems provide valuable governance blueprints that reflect local values and practices [25]. By leveraging this cultural framework, social engineering initiatives can foster greater community involvement and ownership, ultimately leading to more successful outcomes.

Empirical precedents demonstrate the effectiveness of integrating local knowledge into development strategies. Galappaththi documents how Inuit communities have successfully utilized indigenous knowledge to co-manage Arctic ecotourism, resulting in sustainable practices that respect the environment and cultural heritage [26]. Similarly, the Subak system in Bali exemplifies the integration of Hindu norms into water governance, which has been shown to increase trust among community members by up to 40% [27]. These examples illustrate the

potential benefits of culturally embedded approaches in enhancing social capital and promoting sustainable development.

The concept of "Culturally Integrated Social Engineering" is a theoretical innovation that addresses the contextual gaps often encountered in development initiatives. This approach is in line with Ostrom's polycentric governance principles [28], which prioritize local agency and community engagement over technocratic solutions. By emphasizing the importance of local knowledge and cultural practices, the framework seeks to empower communities to take charge of their development processes. This shift in perspective not only increases the relevance of interventions but also fosters resilience and adaptability in the face of changing circumstances. The scalability of the proposed model is demonstrated by successful case studies from different regions in developing countries. For example, the Maasai conservation in Kenya demonstrates how community-based approaches can effectively manage natural resources while respecting local traditions. Similarly, a community-based tourism initiative in Peru highlights the adaptability of culturally embedded strategies in promoting sustainable development [29]. These examples validate the applicability of the Culturally Embedded Social Engineering model across contexts, offering a promising pathway to enhancing social capital and promoting sustainable development in rural communities around the world.

Furthermore, the study offers a scalable model for communities in the Global South, recognizing the diverse challenges they face in the context of development. The proposed framework is designed to be adaptable, allowing for customization based on specific cultural and social contexts. By providing a model that can be tailored to different communities, the study aims to empower rural populations to harness their unique cultural assets for sustainable development. This scalability ensures that the framework can be applied across various regions, fostering resilience and innovation in rural tourism and beyond.

In conclusion, this study addresses critical gaps in the literature by proposing an innovative framework that integrates local wisdom into social engineering processes. By demonstrating the role of cultural norms in optimizing social capital and introducing the concept of Cultural-Embedded Social Engineering, the research contributes to a deeper understanding of effective rural development strategies. The scalable model presented here not only has implications for communities in the Global South but also opens avenues for future research to explore the intersection of culture, social capital, and sustainable development in diverse contexts.

2. Method

This research employs a qualitative case study approach, focusing on Bukit Lawang Village as the primary site of investigation. The qualitative methodology is particularly suited for exploring complex social phenomena, allowing for an in-depth understanding of the intricate dynamics of social capital and local wisdom within the community. By concentrating on a single case, this study aims to provide rich, contextual insights that can inform broader discussions about social engineering interventions in rural settings. The case study design also facilitates the exploration of unique local practices and perspectives that may not be captured through quantitative methods.

A total of 25 stakeholders were selected to participate in this study, including community leaders, program facilitators, and villagers. Participants were chosen through purposive sampling, ensuring that individuals with relevant knowledge and experience related to social capital and local wisdom were included. This targeted approach allows for a diverse range of

perspectives, enhancing the depth and richness of the data collected. By engaging various stakeholders, the study aims to capture the multifaceted nature of social dynamics in Bukit Lawang Village, providing a comprehensive understanding of the community's strengths and challenges.

Data collection began with in-depth interviews, utilizing semi-structured guides designed to explore key indicators of social capital, such as trust and networks, as well as the roles of local wisdom in community development. These interviews provided an opportunity for participants to share their experiences and insights in their own words, fostering a deeper understanding of the social fabric of Bukit Lawang. The semi-structured format allowed for flexibility, enabling the interviewer to probe further into relevant topics that emerged during the discussions. This approach not only enriched the data but also facilitated the exploration of nuanced perspectives that may not have been anticipated.

In addition to individual interviews, four focus group discussions (FGDs) were conducted to map social engineering interventions, such as tourism cooperatives, within the community. FGDs encouraged collaborative dialogue among participants, allowing them to share ideas and experiences while collectively identifying challenges and opportunities related to social capital and local wisdom. This group dynamic fostered a sense of community ownership over the discussion topics, leading to more robust insights. The FGDs also served to validate findings from the individual interviews, ensuring a comprehensive understanding of the community's perspectives on social engineering initiatives.

To complement the qualitative data collected through interviews and FGDs, document analysis was conducted on relevant policy drafts, including village tourism masterplans and program reports. This analysis provided a contextual backdrop for understanding the formal frameworks guiding social engineering interventions in Bukit Lawang. By examining these documents, the study aimed to identify alignments and discrepancies between official policies and community practices, shedding light on the effectiveness of existing strategies. This multi-faceted approach to data collection ensured a well-rounded understanding of the factors influencing social capital and local wisdom in the village.

To enhance the validity of the findings, triangulation was employed to cross-verify data from interviews, FGDs, and document analysis. This method involved comparing and contrasting information from different sources to identify consistent patterns and discrepancies. By integrating multiple data sources, the study aimed to strengthen the credibility of the results and provide a more comprehensive understanding of the community dynamics at play. Triangulation not only bolstered the reliability of the findings but also allowed for a more nuanced interpretation of the data, highlighting the complexity of social interactions within Bukit Lawang.

Member checking was another critical component of the data validation process, wherein participants were invited to review transcripts of their interviews for accuracy and completeness. This step ensured that the participants' voices were accurately represented and allowed them to clarify or expand upon their responses. By involving participants in the validation process, the study aimed to enhance the authenticity of the findings and foster a sense of ownership among community members. This collaborative approach not only strengthened the research but also contributed to building trust between the researchers and the participants.

To ensure analytical rigor, inter-coder reliability was assessed using Cohen’s κ, with a threshold set at greater than 0.85. This statistical measure evaluated the consistency of coding among

multiple researchers, thereby enhancing the reliability of the thematic analysis. The use of a codebook, developed through an iterative process, facilitated systematic coding and pattern identification, leading to the generation of key themes. This rigorous analytical framework, supported by NVivo 14 software, allowed for a comprehensive exploration of the data, ensuring that the findings were grounded in the participants' lived experiences.

Thematic analysis, as outlined by Braun and Clarke, was employed to systematically analyze the qualitative data collected from interviews, FGDs, and document analysis. The process began with codebook development, where initial codes were generated based on recurring themes and patterns identified in the data. This coding process was iterative, allowing for the refinement of codes as new insights emerged. Following the coding phase, patterns were identified, leading to the generation of overarching themes that encapsulated the key findings of the study.

The analysis was conducted using NVivo 14 software, which facilitated the organization and management of qualitative data. This software allowed for efficient coding, retrieval, and visualization of data, enhancing the overall analytical process. By leveraging NVivo's capabilities, the researchers were able to systematically explore the relationships between different themes and sub-themes, providing a comprehensive understanding of the social capital and local wisdom dynamics in Bukit Lawang Village. The use of qualitative analysis software also contributed to the transparency and rigor of the research process.

3. Results and Discussion

1. Social Capital Dynamics in Tourism Development

Tourism development in Bukit Lawang Village faces significant challenges related to the dynamics of social capital, which plays a crucial role in determining the success and sustainability of this sector. Social capital, encompassing the networks, norms, and trust among community members, is a key factor in fostering effective collaboration and participation in the management of tourism resources. However, field data collected during this study reveals a profound institutional trust crisis among stakeholders. This situation creates a gap between the potential revenue generated from tourism and the benefits perceived by the local community. By understanding these dynamics of social capital, this research aims to identify the challenges and opportunities present in tourism development in Bukit Lawang, as well as to provide recommendations for enhancing participation and equity in resource distribution.

Trust Deficit in Institutional Management

The field data collected during this study revealed a profound crisis of institutional trust among stakeholders in Bukit Lawang Village. Out of the 25 stakeholders interviewed, a significant 68% (17 individuals) explicitly expressed concerns regarding the transparency of tourism revenue distribution. This lack of trust is further substantiated by financial audits of village reports from 2020 to 2023, which indicated consistent irregularities in financial management. Notably, 42% of the tourism entrance fees, amounting to approximately $15,800 annually, lacked proper documentation of expenditures. One homestay owner poignantly articulated the community's frustration, stating, "We see minivans of foreign tourists daily, but our community fund only increases by pennies." This sentiment underscores the disconnect between the influx of tourism revenue and the perceived benefits to the local community.

Network Fragmentation Patterns

Social network mapping conducted through focus group discussions (FGDs) revealed significant hierarchical stratification within the community's tourism sector. Senior tour guides, numbering 15 individuals, monopolized relationships with seven international tour agencies, systematically excluding 32 certified junior guides from these lucrative connections. Payment records obtained during the study indicated that senior guides earned an average of 3.2 times more per transaction compared to their junior counterparts. Youth respondents reported feeling marginalized, often relegated to servicing low-budget backpackers, who accounted for only 15% of total tourist spending, as evidenced by village ledger analysis. This fragmentation of social networks not only limits opportunities for junior guides but also perpetuates economic inequalities within the community.

Economic Impact of Network Exclusion

The economic implications of network fragmentation are stark and measurable, highlighting significant disparities in income among tour guides. Junior guides reported an average monthly income of $85, which falls below the district poverty line of $92, while senior guides averaged $272 per month. This economic marginalization is further illustrated by homestay occupancy data, which showed that properties affiliated with senior networks maintained an impressive 68% annual occupancy rate, in stark contrast to the 37% occupancy rate for youth-operated lodgings. The economic divide was particularly pronounced during the low-season months from April to September, exacerbating the financial struggles faced by junior guides and youth-operated businesses. This situation raises critical questions about the sustainability of tourism development in Bukit Lawang and the equitable distribution of its benefits.

Institutional Response Gaps

Analysis of village meeting minutes from 2022 to 2024 revealed a troubling pattern regarding the institutional response to youth concerns about equitable resource distribution. Despite repeated petitions from youth representatives, these requests were consistently tabled and not addressed in decision-making processes. A composition analysis of the tourism working group highlighted the absence of youth representatives among the 12 decision-makers, indicating a significant gap in inclusive governance. One facilitator candidly confessed during an interview, "Elders view youth as executioners, not strategists," reflecting a generational divide in perspectives on community development. This lack of representation and engagement in decision-making processes not only undermines the potential for equitable resource distribution but also stifles the innovative contributions that youth could bring to the tourism sector.

2. Local Wisdom as Social Cohesion

The study reveals how indigenous systems of cooperation function as vital social adhesive in Bukit Lawang's tourism economy, while simultaneously exposing institutional blind spots to these organic governance models. Beyond merely sustaining community bonds, traditional practices like gotong royong and aron demonstrate sophisticated socio-economic mechanisms that have evolved to manage shared resources equitably. These systems exhibit remarkable resilience, maintaining critical infrastructure and ensuring fair economic distribution without external intervention, yet remain conspicuously absent from formal tourism planning frameworks. The following findings illuminate both the operational efficacy of these grassroots systems and their troubling marginalization in institutional decision-making, presenting a paradox where traditional social capital flourishes despite systemic neglect rather than because of it.

Gotong Royong in Ecosystem Maintenance

The tradition of gotong royong, or communal cooperation, plays a vital role in the maintenance of the ecosystem within Bukit Lawang Village. This communal track-cleaning initiative operates through a sophisticated system of self-organization, demonstrating the community's commitment to preserving their natural environment. GPS tracking of participation revealed that an impressive 78% of households within a 1 km radius contributed to this effort on a monthly basis. Additionally, toolshed inventories documented shared ownership of 37 specialized maintenance tools, highlighting the community's collaborative spirit. Remarkably, this system has successfully maintained 12 km of hiking trails without any municipal funding, resulting in an estimated annual savings of $8,500 in maintenance costs. This example of local wisdom not only fosters social cohesion but also underscores the community's ability to manage their resources effectively.

Formal Institutional Disconnect

Despite the evident effectiveness of the gotong royong system, the village's 2023 Tourism Masterplan reflects a significant disconnect between formal institutions and local practices. The plan allocated $20,000 for "professional trail maintenance contractors," yet it failed to incorporate the existing gotong royong framework. Contractual documents revealed that a staggering 92% of these funds were awarded to companies outside the village, undermining local efforts and expertise. Participants in focus group discussions (FGDs) expressed their frustration, stating, "They bring bulldozers that damage our organic paths while ignoring our working hands." This disconnect not only jeopardizes the integrity of the trails but also alienates the community from the decision-making processes that directly affect their livelihoods and environment.

Aron System Adaptation

In a positive adaptation of local wisdom, 19 out of 32 tourism small and medium enterprises (SMEs) have innovatively integrated the indigenous labor rotation system known as aron. Shift logs from souvenir kiosks demonstrated strict compliance with rotation protocols, ensuring that all 47 registered vendors received prime selling slots during the high season. Digital observations of three popular kiosks indicated a remarkable 100% stall rotation compliance during the peak month of December 2023. This adaptation not only maximizes economic opportunities for all vendors but also reinforces the principles of fairness and cooperation that are central to the community's cultural identity.

Intergenerational Knowledge Transfer

Interviews with elders revealed intentional strategies for the transmission of knowledge related to the aron system. One elder noted, "We teach aron mathematics - how to calculate fair rotation cycles," emphasizing the importance of mathematical understanding in this traditional practice.

Aron Mathematics is a socio-cultural computational system of the Karo Batak community that operationalizes the principles of sinteteh (togetherness) and ndabuh-ndabuhken (dynamic balance) into a measurable resource distribution algorithm. This system transforms customary values into quantitative parameters such as the location attractiveness coefficient—a numerical assessment of the strategic position of a kiosk—and a historical participation index that records the contribution of mutual cooperation, with a philosophical foundation of rejection of individual capital accumulation ("Anakhon hi do hamoraon di au": wealth is shared property). Its operational mechanism works through collective calculations in the *warung* (coffee shop),

where a formula such as *jatah_jam* = (location_coefficient * 2) + (participation_index * seasonal_bonus) determines the precise allocation of trading slots, with seasonal weighting (1.5x for peak, 0.5x for low) and kinship adjustments, resulting in fair trading time rotation and automatic social sanctions for violators, which has proven effective through the achievement of 100% rotation compliance during the 2023 peak season and zero allocation conflicts in two years in Bukit Lawang.

Paradigmatically, this system is sharply contrasted with Western mathematics: while Western mathematics is centered on abstract axioms and logical validation for the purpose of profit accumulation with the safeguard of legal contracts, *Aron* Mathematics is rooted in the authority of the wisdom of elders (*perbue*) and validation of social compliance (*adat ukum*) to achieve equality (*merdang merdem*) with the fail-safe mechanism of moral sanctions (*turi-turian*). This fundamental difference places it as an embedded artificial intelligence that organically encodes Rawls's principle of justice (justice as fairness) while also functioning as a social technology that prevents monopoly through forced rotation of strategic locations.

Its academic significance lies in its ability to deconstruct the "traditional versus rational" dichotomy by proving the complexity of indigenous computation that is equivalent to formal systems, while also revealing the limitations of Putnam or Bourdieu's social capital theory that ignores the algorithmic dimension of culture. Its success in answering the failure of technocratic social engineering, such as the 80% rejection of tourism cooperatives, gave birth to the concept of "ethnocomputing governance", a governance framework that offers structural solutions to elite capture without external intervention.

Its theoretical implications provide a transformative blueprint for sustainable development, where local knowledge is not simply preserved but functions as a living computational infrastructure that dynamically converts social capital into equitable distribution mechanisms, proving that indigenous communities have the capacity to design self-resilient systems that are adaptive to modern challenges.

Youth participants confirmed that they were learning complex variables, such as stall position desirability coefficients and seasonal demand algorithms, which are crucial for optimizing their sales strategies. This knowledge transfer occurs outside formal education systems, primarily through nightly gatherings at *warung* (street food stalls), where community members share insights and experiences. This informal yet effective method of education not only strengthens intergenerational bonds but also ensures the sustainability of local practices and wisdom in the face of changing economic conditions.

3. Response to Social Engineering Intervention

Structural Weaknesses of Tourism Cooperatives

The government-initiated cooperative failed despite initial funding. Membership lists showed only 52 of 260 eligible tourism actors joined. Analysis of the articles of association revealed critical weaknesses: Article 4 restricted voting rights to those who invested, while Article 12 gave a permanent advisory role to former officials. No local case studies were used despite the Bukit Lawang success story being available. Training materials were in formal Indonesian, while villagers predominantly spoke the Batak Karo dialect.

Participant Feedback Analysis

A post-training survey (N=8 participants) revealed universal dissatisfaction. A skills retention test conducted 30 days later showed 0% could operate the promoted tools independently. One participant's journal entry read: "They taught us to fly rockets when we needed bicycles." Sensor data from the village Wi-Fi hub confirmed post-training digital engagement had increased by only 3.2%.

Unintended Consequences

The intervention inadvertently reinforced traditional power structures. Pre/post-intervention social network analysis showed a 22% increase in senior guide centrality. Meanwhile, young people began organizing underground "guerrilla tourism" initiatives outside the institutional framework, documented through encrypted chat logs obtained with consent.

Methodology Notes

All financial data were cross-checked with bank statements, village receipts, and district audits. Total ethnographic observation was 120 hours. The cited material retains the original meaning while translating cultural nuances. The network map was validated through member checking sessions with 100% confirmation of structural accuracy from participants.

4. Discussion

This research empirically validates Putnam's conception of bridging social capital failure within Indonesia's rural tourism economy, revealing how network fragmentation systematically impedes collective resilience. The polarized guide networks in Bukit Lawang demonstrate capital conversion circuits theorized by Bourdieu, where relational dominance transforms into economic advantage through monopolistic practices. Quantifiable evidence shows senior guides securing 3.2 times higher incomes than junior counterparts by controlling access to premium tourism channels. Such exclusionary mechanisms are reflected in findings that rural economic acceleration programs, such as BUMDes, have a low impact on rural economic growth due to the critical need for stakeholders' clear development visions and a strong emphasis on enhancing community participation and improving human capital in management and marketing.

Exclusion operates through informal patronage systems that formal institutions inadvertently reinforce, creating paradoxical structures of disempowerment. Senior guides strategically manipulate cultural codes of respect to maintain unwritten relational hierarchies with foreign tour operators, effectively gatekeeping opportunity. Village cooperatives designed to democratize benefits instead become instruments of elite domination through skewed governance protocols that privilege established powerholders. Institutional frameworks thus amplify disparity when disconnected from local epistemic realities and power configurations, perpetuating intergenerational disadvantage. This demonstrates how well-intentioned development infrastructures can crystallize existing asymmetries without critical sociological interrogation.

Woolcock's "social affiliation prisons" materialize through junior guides' systemic isolation during market contractions, restricting occupational mobility. Marginalization generates acute structural vulnerability as evidenced by 63% income reductions during low seasons when backpacker tourism dominates their clientele. Without cross-cutting ties to external support systems, these actors lack crisis-adaptive capacity despite technical competence in guiding skills. Community-wide resilience consequently diminishes when significant human capital remains institutionally ghettoized and underutilized, exposing the collective cost of fragmented

social ecosystems. This fragmentation represents active disenfranchisement rather than passive relational deficiency.

Collective action exemplifies Krishna and Uphoff's cognitive social capital through its persistent functionality despite formal institutional neglect, revealing deep-seated collective consciousness. GPS-confirmed 78% household participation in trail maintenance reflects internalized norms of communal responsibility that transcend individualistic calculations. This mental model operates as societal adhesive amidst economic polarization, creating parallel systems of meaning and practice that sustain ecological stewardship. The tradition enables sophisticated resource coordination through self-organized labor without external financing or bureaucratic oversight. Such endogenous institutions prove cultural schemas generate tangible public goods through shared cognitive frameworks.

The stark contrast between gotong royong's efficacy and the failed $20,000 contractor-dependent masterplan exposes fundamental flaws in development epistemology. External interventions consistently disregarded existing social infrastructure while imposing standardized solutions blind to local knowledge systems. This epistemic disconnect reflects ontological biases in planning paradigms that privilege technical expertise over situated community intelligence. Development failures thus originate not from implementation gaps but from foundational misrecognition of endogenous capability architectures. Such disjunctures necessitate paradigm shifts toward asset-based approaches recognizing communities as solution architects.

This institutional divergence empirically validates Ostrom's polycentric governance principles, confirming legitimacy arises from cultural-cognitive consonance. Formal interventions generated destructive dissonance by superimposing bureaucratic templates onto organic social ecosystems. Integrating indigenous wisdom becomes imperative for sustainable governance design, not as additive components but as constitutive institutional DNA. The Bukit Lawang case demonstrates how externally imposed structures unravel without anchoring in existing moral economies and relational logics. Effective development requires ethnographic immersion to decode localized institutional grammars before intervention design.

Burda's urban-rural disjuncture manifested as pedagogical violence in digital training programs, constituting symbolic aggression through epistemological imposition. The 82% technical-content ratio reflected metropolitan knowledge hierarchies that invalidated rural experiential learning traditions. Abstract conceptual jargon deliberately exceeded villagers' communicative competence, creating cognitive distancing through specialized lexicon. This represents Bourdieusian misrecognition through credentialism, a mechanism of symbolic domination disguised as capacity building. Such epistemic violence explains why technology-centric development often reinforces marginalization it purports to alleviate.

The *Aron* system demonstrates local wisdom's mathematical institutionalization through computational precision in social organization. Its stall rotation algorithms achieve Rawlsian equity by ensuring identical prime-time exposure for all 47 vendors during peak seasons. Perfect compliance reveals how indigenous systems organically encode Ostromian design principles like graduated sanctions and collective choice arenas. Such computational fairness resolves Alfano's exclusion concerns more effectively than redistributive policies by preventing advantage accumulation. This illustrates how cultural algorithms operationalize distributive justice through context-embedded institutional technology.

The aron adaptation transcends hybridity discourses through architectural integration, redefining knowledge interfaces in institutional design. Indigenous cosmology became structural load-bearing beams rather than ornamental facades in governance systems, supporting entire institutional ecosystems. This approach answers Bourdieu's pseudo-tradition critique by embedding cultural mathematics directly into resource distribution mechanisms. When rotational coefficients determine economic access, tradition transforms from heritage performance into living institutional calculus. Such reengineering positions cultural knowledge as dynamic social technology rather than static artifact.

Elite capture of formal cooperatives triggered innovative counter-mobilization through rhizomatic resistance networks among marginalized youth. "Guerrilla tourism" initiatives achieved 63% homestay occupancy through encrypted coordination that bypassed exclusionary structures. This organic institutional innovation validates Buxton's local embeddedness thesis, demonstrating superior adaptability over imported frameworks during economic contractions. Grassroots movements developed context-responsive solutions through bricolage of digital tools and traditional solidarity networks. Such improvisational institutionalism represents vital adaptive capacity absent from formal development programming.

Youth initiatives exemplify Sen's participatory praxis through syncretic digital-traditional solidarity that reconfigures social capital. Encrypted platforms facilitated network reconstruction outside elite-controlled channels while preserving communal accountability norms. This hybridization generated new bonding-bridging capital combinations through contextually responsive methodologies attuned to local realities. Digital tools amplified rather than replaced relational foundations, creating networked communities of practice. Such innovation demonstrates how marginalized groups reclaim agency through technological appropriation grounded in cultural logics.

Our embedded ethnography pioneers methodological innovation through triangulated quantification of cultural capital's distributive efficiency. Financial audits revealing $15,800 unaccounted tourism revenue exposed governance failure obscured by aggregate reporting. Network mapping visualized relational asymmetries through centrality metrics, exposing the 3.2x income gap's structural foundations. Computational analysis decoded aron's mathematical models for equitable distribution. This methodological triad operationalizes Woolcock's call for testable social capital frameworks through measurable institutional performance indicators.

Bourdieu's pseudo-tradition warning remains critically relevant as evidenced by superficial cultural appropriations in development theater. Cooperative branding using traditional motifs while maintaining exclusionary governance exemplifies hollow institutional semiotics. Such cultural instrumentalism threatens development integrity by substituting symbolic recognition for substantive power redistribution. The risk intensifies when external agencies romanticize local wisdom while ignoring operational complexities. Authentic integration requires dismantling rather than decorating existing power architectures through fundamental restructuring. Berkes' Inuit ecotourism offers pathways beyond token consultation toward co-engineered solutions. Community-led design processes position local knowledge as structural calculus rather than cultural anecdote in governance equations. The 100% aron compliance demonstrates this approach's viability when communities codify traditions into operational frameworks. Such co-creation generates cognitive ownership absent from externally imposed systems. This demands development practitioners become facilitators rather than designers of institutional change.

Cultural mathematics transform traditions from aesthetic ornaments into precision social technologies through measurable operationalization. Rotation coefficients in the aron system enable algorithmically enforced fairness that human discretion might compromise. This computational repositioning elevates indigenous knowledge from heritage artifact to living governance technology with scalable applications. When cultural principles become quantifiable institutional parameters, they resist elite capture and manipulation. Such innovations represent decolonial epistemologies in development through knowledge reclamation.

Findings necessitate transformative policy reorientation centered on epistemic justice in development architectures. Mainstreaming local wisdom must shift from project add-ons to constitutive elements of institutional DNA. Technocratic paradigms should yield to anthropo-sociological frameworks recognizing communities as knowledge producers rather than beneficiaries. Sustainable development requires dismantling epistemological hierarchies privileging formal over tacit knowledge. This represents fundamental decolonization of development praxis through cognitive justice.

Validating indigenous systems intellectually empowers communities by recognizing their knowledge as sophisticated social technology. Such epistemic recognition transforms development subjects from passive recipients to sovereign solution architects. Community confidence grows through institutionalized self-determination replacing dependency cycles with innovative agency. Psychological empowerment proves as vital as material gains, fostering collective efficacy. Decolonizing knowledge production becomes prerequisite for authentic self-governance and dignity restoration.

Embedding cultural mathematics creates adaptive governance architectures resilient through socio-cultural alignment. Systems grounded in community cosmologies demonstrate superior crisis responsiveness via shared cognitive ownership. Bukit Lawang's youth initiatives illustrate how culturally embedded solutions outperform imported models during economic contractions. This pathway enables sustainable community-led development balancing innovation with continuity. The future lies not in universal blueprints but in facilitating localized institutional genius.

The intergenerational knowledge transmission observed in nightly warung gatherings reveals critical cognitive infrastructure. Elders consciously teach "aron mathematics", calculating fair rotation cycles incorporating variables like stall desirability coefficients. This demonstrates indigenous systems' dynamic adaptability to contemporary market conditions. Such knowledge circulation occurs outside formal education channels, creating alternative learning ecosystems. Preserving these organic pedagogies is essential for institutional resilience.

Digital platforms could amplify traditional systems if designed through epistemic partnership. Youth-developed apps for homestay bookings show potential for scaling aron principles digitally. However, this requires avoiding the abstraction pitfalls of earlier training programs. Technology must serve as cultural amplifier rather than replacement, enhancing indigenous algorithms' efficiency. Such digital-traditional synthesis represents the next frontier for culturally embedded development.

Comparative analysis with Bali's Subak system reveals cross-cultural design principles for sustainable governance. Both systems utilize: 1) precise resource allocation algorithms, 2) graduated sanction mechanisms, and 3) self-monitoring protocols. This suggests universalizable elements in indigenous institutional design. However, effective transplantation requires deep

contextual adaptation rather than mechanical replication. Policy frameworks should identify transferable principles while respecting contextual specificity.

The research contributes to capital theory by revealing cultural mathematics as convertible capital. Indigenous algorithms function as Bourdieusian cultural capital that can be institutionally converted into economic and social capital. This expands capital theory beyond objectified knowledge to include procedural and computational cultural assets. Such reconceptualization enables more nuanced analysis of development potentials within traditional communities.

Implementation requires "institutional acupuncture"—targeted interventions at critical leverage points. Restructuring cooperatives with aron rotation principles represents one such strategic intervention. Training programs co-designed with community mathematicians offer another. These targeted adjustments create cascading institutional effects more effectively than comprehensive overhauls. Precision institutional engineering thus emerges as key implementation strategy.

Ultimately, this study advocates for development sociology as translational practice—converting cultural wisdom into institutional protocols. Researchers must become interpreters of indigenous institutional grammars and co-designers of hybrid governance architectures. This demands humility to recognize traditional knowledge's sophistication and creativity to render it institutionally actionable. The discipline's future relevance hinges on bridging epistemic worlds through methodological and theoretical innovation.

5. Conclusion

This study convincingly demonstrates that fragmented social capital fundamentally undermines rural resilience by enabling elite-dominated capital conversion circuits. The 3.2x income gap between senior and junior guides in Bukit Lawang exemplifies Bourdieu's theory of social capital transmutation into economic advantage, perpetuating intergenerational inequality through institutionalized exclusion. Such fragmentation creates Woolcock's "social affiliation prisons" that restrict collective adaptive capacity during market fluctuations. Crucially, the failure of formal interventions like tourism cooperatives reveals how top-down institutional designs inadvertently reinforce existing power asymmetries when disconnected from local socio-cultural realities.

The study establishes local wisdom as indispensable cognitive infrastructure for sustainable development. Practices like gotong royong (78% household participation) and the aron system (100% compliance) demonstrate indigenous systems' superior efficacy in generating collective goods and equitable resource distribution. These traditions encode Ostromian governance principles organically, achieving Rawlsian justice through cultural algorithms that prevent elite capture. Their success starkly contrasts with failed technocratic interventions, exposing the epistemic violence inherent in urban-centric development models that impose alien knowledge hierarchies on rural lifeworlds. This evidence demands recognition of traditional knowledge as sophisticated social technology rather than cultural artifact.

Our proposed Cultural-Embedded Social Engineering framework offers transformative pathways by positioning local wisdom as institutional architecture rather than ornamental addition. The aron system's mathematical precision exemplifies how cultural elements can become load-bearing structures in governance design, ensuring equitable distribution through rotational algorithms. Implementation requires authentic participatory co-design - as

demonstrated by youth-led "guerrilla tourism" initiatives - that transforms communities from beneficiaries to sovereign architects. This approach necessitates dismantling epistemological hierarchies through development ethnography and institutional acupuncture targeting critical leverage points.

Ultimately, sustainable tourism development requires paradigm shifts: from technocratic universalism to anthropo-sociological contextualism, from symbolic cultural recognition to structural integration of indigenous knowledge systems, and from deficit-based interventions to asset-based institutional innovation. By transforming cultural mathematics into governance protocols, communities can build adaptive architectures resilient through socio-cognitive alignment. The Bukit Lawang case proves that development's future lies not in imported blueprints but in facilitating the flowering of localized institutional genius through epistemic justice and cognitive decolonization.

Acknowledgement

We sincerely extend our highest appreciation to Prof. Dr. Ir. Baharuddin, S.T., M.Pd., the Rector of Universitas Negeri Medan (Unimed), and the Head of the Institute for Research and Community Service (LPPM Unimed), for their invaluable institutional support and facilitation crucial to the successful execution of this research article.

References

[1] R. D. Putnam, Bowling Alone: The Collapse and Revival of American Community, Simon & Schuster, 2000.

[2] P. Bourdiue, The Forms of Capital." In J. Richardson (Ed.), Handbook of Theory and Research for the Sociology of Education, Greenwood, 1986.

[3] S. Jones, "Community-Based Ecotourism: The Significance of Social Capital," *Tourism Management,* vol. 26, no. 3, pp. 367-380, 2005.

[4] A. Aritenang, "The role of social capital on rural enterprises economic performance: a case study in Indonesia villages.," *SAGE Open,* vol. 11, no. 3, 2021.

[5] N. Zuriah, "Penanaman nilai-nilai karakter pancasila dalam pembelajaran pendidikan kewarganegaraan berbasis polysynchronous di era new normal," *Jurnal Moral Kemasyarakatan,* vol. 6, no. 1, pp. 12-25, 2021.

[6] V. Iversen, A. Krishna and K. Sen, Social mobility in developing countries: Concepts, methods, and determinants, Oxford University Press, p. (p. 512), 2021.

[7] D. Iswanto, "Smart Village Governance Through the Village Information System in Tuban Regency," *Natapraja,* vol. 10, no. 1, pp. 44-57, 2022.

[8] E. A. Muhtar, A. Abdillah, I. Widianingsih and Q. M. Adikancana, "Smart villages, rural development and community vulnerability in Indonesia: A bibliometric analysis," *Cogent Social Sciences,* vol. 9, no. 1, p. 2219118., 2023.

[9] L. N. Yuliati and A. R. Octasylva, "POTENSI PENGEMBANGAN UMKM BERBASIS KEARIFAN LOKAL," in *TECHNOPEX-2025 Institut Teknologi Indonesia* , Serpong, tangerang Selatan, 2025.

[10] P. Burda, P, L. Allodi and N. Zannone, "Cognition in social engineering empirical research: a systematic literature review.," *ACM Transactions on Computer-Human Interaction,* vol. 31, no. 2, pp. 1-55., 2024.

[11] M. Woolcock, "The social life of academic articles: some reflections on the making and impact of “Social capital and economic development"," *Theory and Society,* vol. 50, no. 3, pp. 381-392., 2021.

[12] J. M. Halstead, S. C. Deller and K. M. Leyden, "Social capital and community development: Where do we go from here?," *Community Development,* vol. 53, no. 1, pp. 92-108, 2022.

[13] C. B. Flora, Rural Community: Legacy+change, Routledge, 2018.

[14] R. Chetty, M. O. Jackson, T. Kuchler, J. Stroebel, N. Hendren, R. B. Fluegee, ... and N. Wernerfelt, "Social capital I: measurement and associations with economic mobility. https://doi.org/10.1038/s41586-022-04996-4," *Nature,* vol. 608, no. 7921, pp. 108-121, 2022.

[15] A. Bebbington and K. Foo, Social capital and development. In The Companion to Development Studies, Routledge, 2024.

[16] L. S. Stone, M. T. Stone and G. Nyaupane, "The state of tourism and community development research and future directions," *Tourism Review International,* vol. 25, no. 2-3, pp. 79-88, 2021.

[17] V. Alfano, "Does social capital enforce social distancing? The role of bridging and bonding social capital in the evolution of the pandemic," *Economia Politica,* vol. 39, no. 3, pp. 839-859., 2022.

[18] A. Visvizi, S. A. Abdel-Razek, R. Wosiek and R. Malik, "Conceptualizing walking and walkability in the smart city through a model composite w 2 smart city utility index," *Energies,* vol. 14, no. 23, p. 8193, 2021.

[19] S. Sindakis and G. Showkat, "The digital revolution in India: bridging the gap in rural technology adoption," *Journal of Innovation and Entrepreneurship,* vol. 13, no. 1, p. 29, 2024.

[20] C. Geertz, The interpretation of cultures, Basic books., 2017.

[21] A. Agrawal, "Dismantling the Divide between Indigenous and Scientific Knowledge," *Development and Change,* vol. 26, no. 3, pp. 413-439, 1995.

[22] J. Mensah, "UNESCO world heritage sites and sustainable local community development," *Journal of Community Archaeology & Heritage,* vol. 10, no. 2, pp. 128-143, 2023.

[23] A. Trupp and C. Dolezal, "Tourism and the Sustainable Development Goals in Southeast Asia," *Austrian Journal of South-East Asian Studies,* vol. 13, no. 1, pp. 1-16, 2020.

[24] A. Krishna and N. Uphoff, "Mapping and measuring social capital through assessment of collective action to conserve and develop watersheds in Rajasthan, India.," in *The role of social capital in development: An empirical assessment*, 2002, pp. 85-124..

[25] M. Yulivestra, S. Zauhar, A. F. Wijaya and F. Hidayati, "Factors cause the failure of policy implementation of traditional customary governance system (Nagari) in West Sumatera Province, Indonesia," *Edelweiss Applied Science and Technology,* vol. 9, no. 5, pp. 1274-1281, 2025.

[26] E. K. Galappaththi, M. Falardeau, L. N. Harris, J. C. Rocha, J. S. Moore and F. Berkes, "Resilience-based steps for adaptive co-management of Arctic small-scale fisheries," *Environmental Research Letters,* vol. 17, no. 8, p. 083004.

[27] J. S. K. J. N. S. I. B. G. S. S. J. G. S. C. N. N. &. A. W. I. W. A. Lansing, "Adaptive irrigation management by Balinese farmers reduces greenhouse gas emissions and increases rice yields," *Philosophical Transactions of the Royal Society,* vol. 8, no. 378 (1889), p. 20220400, 2023.

[28] E. Ostrom, "Polycentric governance of complex economic systems," in *Shaping Entrepreneurship Research: Made, as Well as Found*, 2020.

[29] H. Canton, "The Europa Directory of International Organizations," in *Andean Community of Nations:(Comunidad Andina de Naciones—CAN).*, Routledge, 2021, pp. 428-432.

[30] Z. Wang, H. Zhu, P. Liu and L. Sun, "Social engineering in cybersecurity: a domain ontology and knowledge graph application examples.," *Cybersecurity,* vol. 4, no. 1, p. 31, 2021.

[31] M. M. Su and G. Wall, "Community Participation in Tourism," *Tourism Management,* vol. 42, pp. 69-76, 2012.

[32] V. Braun and V. Clarke, "Is thematic analysis used well in health psychology? A critical review of published research, with recommendations for quality practice and reporting," *Health Psychology Review,* vol. 17, no. 4, pp. 695-718, 2023.