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COLLABORATION IN COMMUNITY EMPOWERMENT INNOVATION FOR ACCELERATING SUSTAINABLE VILLAGE DEVELOPMENT IN SERANG DISTRICT

KOLABORASI INOVASI PEMBERDAYAAN MASYARAKAT UNTUK PERCEPATAN PEMBANGUNAN DESA BERKELANJUTAN DI KABUPATEN SERANG

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Abstract

Serang Regency has 326 villages with great agricultural, industrial, and coastal potential, but still faces north-south regional disparities, 18% stunting, and low digital literacy and female participation in the economy. This study examines the effectiveness of innovative pentahelix-based collaboration as a strategy for accelerating sustainable village development in Serang Regency within the framework of the Village SDGs and the 2025-2045 RPJPD vision. The objectives of this study are (1) to analyze the forms and mechanisms of pentahelix collaboration, (2) to evaluate its impact on improving the Village Development Index and achieving Village SDGs, and (3) to formulate concrete policy recommendations for the Serang Regency Government. The benefits of this study include operational guidelines for regional policy makers, replication of the model in similar areas in Banten, and contribution to the national target of independent villages towards Indonesia Emas 2045. The methodology used is descriptive qualitative with a systematic literature review and secondary document analysis. The results show that pentahelix collaboration has succeeded in increasing the average IDM by 18.71%, reducing village poverty by 4.08%, and strengthening the circular economy. Recommendations include allocating 15% of Village Funds for digital platforms and forming a district pentahelix task force.

Keywords: Pentahelix Collaboration, Village SDGs, Sustainable Development, Serang District, Village Innovation.

Abstrak

Kabupaten Serang memiliki 326 desa dengan potensi agraris, industri, dan pesisir yang besar, namun masih menghadapi ketimpangan wilayah utara-selatan, stunting 18 %, serta rendahnya literasi digital dan partisipasi perempuan dalam ekonomi. Penelitian ini mengkaji efektivitas kolaborasi inovatif berbasis pentahelix sebagai strategi percepatan pembangunan desa berkelanjutan di Kabupaten Serang dalam kerangka SDGs Desa dan visi RPJPD 2025-2045.Tujuan penelitian adalah (1) menganalisis bentuk dan mekanisme kolaborasi pentahelix, (2) mengevaluasi dampaknya terhadap peningkatan Indeks Desa Membangun dan pencapaian SDGs Desa, serta (3) menyusun rekomendasi kebijakan

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konkret bagi Pemerintah Kabupaten Serang. Manfaat kajian meliputi panduan operasional bagi pemangku kebijakan daerah, replikasi model di wilayah serupa di Banten, serta kontribusi pada target nasional desa mandiri menuju Indonesia Emas 2045.Metodologi yang digunakan bersifat kualitatif deskriptif dengan kajian literatur sistematis dan analisis dokumen sekunder. Hasil menunjukkan kolaborasi pentahelix berhasil meningkatkan IDM rata-rata 18,71 %, menurunkan kemiskinan desa 4,08 %, dan memperkuat ekonomi sirkular. Rekomendasi mencakup alokasi 15 % Dana Desa untuk platform digital dan pembentukan satgas pentahelix kabupaten.
Kata Kunci: Kolaborasi Pentahelix, SDGs Desa, Pembangunan Berkelanjutan, Kabupaten Serang, Inovasi Desa.

I. INTRODUCTION

Village development in Indonesia has undergone significant transformation since the era of regional autonomy, where the focus has shifted from a centralistic approach to a participatory model that places the community as the main actor. In the global context, this initiative is in line with the United Nations (UN) Sustainable Development Goals (SDGs) agenda, which targets the elimination of poverty, environmental sustainability, and inclusive growth by 2030. However, local adaptation is crucial due to the diverse characteristics of Indonesian villages, ranging from agricultural to coastal areas, which require a contextual framework. This is where the Village SDGs ( ) emerged as a national policy innovation, converting 17 global goals into 18 more operational village priorities, covering economic, social, environmental, and governance aspects. This approach not only simplifies implementation but also ensures that village development contributes directly to national targets such as reducing extreme poverty to zero and increasing the independent village index (Ministry of Villages, Disadvantaged Regions, and Transmigration [Kemendes PDTT], 2020: 5). Through the Village SDGs Roadmap document, this policy sets out strategic stages until 2030, with an emphasis on integrating the Village Fund as the main instrument for green infrastructure and local economic empowerment.

At the national level, Village SDGs have driven a paradigm shift, where villages are no longer passive recipients of aid but active partners in planning and evaluation. Recent research shows that this adaptation has succeeded in increasing village budget efficiency by up to 25% through synchronization with sustainability indicators, although challenges such as low capacity of village officials still pose obstacles (Sarmadan & Kasim, 2025: 45). Furthermore, a bibliometric study reveals that scientific publications on Village SDGs in Indonesia have surged since 2020, with a primary focus on policy synergies to address rural-urban disparities, reflecting the urgency of local adaptation to support the Indonesia Emas 2045 vision (Pratiwi et al., 2025: 126). The empowerment guidebook also emphasizes that this framework must be based on holistic principles, where community empowerment serves as a bridge between global goals and village realities, including through the strengthening of institutions such as Village-Owned Enterprises (BUMDes) for economic diversification (Utami, 2022: 78).

Serang Regency, as one of the main pillars of Banten Province, represents a unique dynamic in this context. This region serves as a transition zone between the southern agricultural area, which depends on *subsistence* farming, and the northern industrial corridor, which is integrated with the Cilegon manufacturing cluster. With an area of 1,734 km² and 326 villages, Serang has abundant agricultural potential, such as productive rice fields and mangrove ecosystems, while also serving as a logistical buffer for Greater Jakarta through the Port of Merak. However, this strategic position comes with deep structural challenges. Rural poverty reached 11.2% in 2024, particularly in rural subdistricts such as Padarincang and

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Cikeusal, where dependence on primary sectors such as agriculture and fisheries makes communities vulnerable to commodity price fluctuations and climate change (Serang Regency Government, 2025: 52). Environmental degradation further exacerbates the situation, with tidal flooding threatening 20% of coastal areas and declining soil fertility due to illegal extractive practices, affecting 15% of disadvantaged villages.

Empirical studies in Serang highlight that this dependence not only hinders economic growth but also weakens social resilience, where women's participation in village decision-making is only 35% and child stunting is still above 18% (Yusfi et al., 2024: 118). A decade-long review of national village development policies confirms that areas such as Serang require special interventions to integrate the SDGs, as spatial disparities between industrial and agricultural zones often result in unequal resource allocation (Hakim & Hanif, 2025: 33). Here, innovative collaboration is key to transformation. The Pentahelix approach—involving local government, academics such as Sultan Ageng Tirtayasa University (Untirta), local businesses, village communities, and the media—enables the integration of multi-sector actors to create an adaptive development ecosystem. Innovations such as *the* SDGs digital monitoring *platform* and AI-based BUMDes incubators, for example, can accelerate the achievement of independent villages by increasing the efficiency of Village Funds by up to 20% and community participation by 30% (Saskara et al., 2024: 12).

The importance of this collaboration lies in its ability to overcome sectoral silos that have long hindered progress. In Serang, initiatives such as the KAMI BERSEMI program involving PT PLN, Untirta, and the community have produced a *zero-waste* waste management model, which not only supports SDG 11 (sustainable settlements) but also creates an economic circulation of IDR 53 million per month from recycled MSMEs. A similar approach is recommended in recent literature, where *multi-stakeholder* synergy is considered a key catalyst for accelerating village transformation, especially in industrial buffer zones like Serang that must balance economic growth with environmental conservation (Wibowo et al., 2025: 4). Without innovative collaboration, development efforts risk being trapped in a cycle of dependency, failing to realize *resilient* and inclusive villages. Therefore, this study emphasizes the urgency of the Pentahelix model as a policy strategy to accelerate the adaptation of Village SDGs, ensuring that Serang Regency not only survives but also leads in the national sustainable development narrative.

Problem Formulation

Although Serang Regency has increasing Village Funds and a strategic position as a national economic buffer, the achievement of Village SDGs is still slow and uneven. The 2024 Village Development Index (IDM) data shows that of 326 villages, only 18.71% are classified as Independent, 54% are still Developing, and 27% are classified as Underdeveloped or Very Underdeveloped, with the highest concentration in the southern region which depends on seasonal agriculture (Serang Regency Community and Village Empowerment Agency, 2024: 19).

Community participation in the village development planning process is still very low. A survey of 120 villages in 2023–2024 revealed that only an average of 38–42% of residents attended or were actively involved in the Village Development Planning Meetings (Musrenbangdes). This low level of involvement is particularly evident among women, youth, and people with disabilities (Natalia & Supardal, 2025: 576). As a result, many Village Fund programs are designed without considering the real priorities of the community, so they are often not sustainable after the project period ends.

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The limitations of digital innovation in rural areas are the second crucial obstacle. By the end of 2024, 4G/5G internet coverage in villages in Serang Regency had only reached 68%, and only 42% of village heads and their staff had basic information technology skills (Serang Regency Government, 2025: 47). This situation has resulted in low utilization of applications such as SID, Siskeudes, and *the* Village SDGs monitoring *platform*, causing development data to be *delayed* and decision-making to be slow (Pratiwi et al., 2025: 128).

Third, there are sharp disparities between regions. The northern zone (districts such as Anyer, Cinangka, Mancak), which is close to the Cilegon industrial area, enjoys high economic growth but also experiences environmental pressure and land inflation. In contrast, the southern zone (Padarincang, Cikeusal, Cibadak, Petir) still depends on *subsistence* agriculture with low productivity and is vulnerable to climate change. This gap is reflected in poverty rates: 6.8% in the north versus 16.4% in the south (Serang District BPS, 2024: 34). As a result, SDG 1 (no poverty) and SDG 8 (decent work and economic growth) targets are difficult to achieve simultaneously across all regions.

Fourth, the lack of synergy between stakeholders is a systemic obstacle. Research in 15 villages in Banten shows that Pentahelix collaboration is only sporadic and project-based, rather than institutional. Academics, the business world, and the media are still rarely involved structurally in the planning and implementation of the Village Fund (Saskara et al., 2024: 14). In fact, without institutionalized cross-sectoral involvement, innovations such as digital BUMDes incubators, *online* markets for village products, or precision agricultural technology cannot be scaled up (Wibowo et al., 2025: 5).

Fifth, weak data-based monitoring and evaluation mechanisms make it difficult to measure the impact of many programs on the 18 SDGs for villages. Only 31% of villages in Serang reported complete and timely SDG data in 2024 (Kemendes PDTT, 2025: 22). This hinders evidence-based budget allocation and prolongs the cycle of underdevelopment.

Thus, the main problem formulation in this study is: "How to build an innovative Pentahelix-based collaboration model that can increase community participation, accelerate the adoption of digital innovation, reduce inter-regional disparities, and strengthen synergies between stakeholders to achieve SDG 1 (no poverty) and SDG 8 (decent work and economic growth) in Serang Regency more quickly and sustainably?"

Research Objectives

This study focuses on three interrelated main objectives, designed to contribute conceptually and practically to addressing the dynamics of rural development in Serang District. First, it analyzes the innovative Pentahelix-based collaboration model as the main framework for empowering rural communities. The Pentahelix approach, which involves synergy between local government, academic institutions such as Sultan Ageng Tirtayasa University (Untirta), local businesses, community members, and the role of the media as a catalyst for transparency, is considered an adaptive strategy for integrating heterogeneous resources. This analysis will explore how this model can be applied to strengthen the collective capacity of the community, including through digital skills training and the development of institutions such as BUMDes, so that the village community is no longer an object of development, but a proactive subject in managing local potential such as organic agribusiness in the southern region of Serang (Deviastri & Annisa, 2022: 8). This study will identify key elements of the model, such as cross-sector coordination mechanisms and success indicators, with the aim of building a deep understanding of how Pentahelix can change the empowerment

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paradigm from reactive to proactive, in line with the principle of inclusiveness in the Village SDGs.

Second, it will evaluate the impact of this collaboration model on accelerating sustainable village development in Serang District. This evaluation includes measuring effectiveness in terms of increasing the efficiency of Village Fund allocation, reducing disparities between regions (e.g., between the northern industrial zone and the southern agricultural zone), and contributing to the achievement of SDG indicators such as SDG 1 (no poverty) and SDG 8 (decent work). Through secondary data analysis from IDM reports and the 2024-2025 Village SDGs Data Collection, the study will assess how Pentahelix collaboration can accelerate the transformation of villages from underdeveloped to self-sufficient, with a projected 25% increase in the village index within three years. This impact will be evaluated multidimensionally, covering economic aspects (such as digital-based MSME diversification), social aspects (increasing women's participation to 40%), and environmental aspects (reduction of land degradation through sustainable agricultural practices), as supported by findings that Pentahelix synergy in Indonesian tourist villages has succeeded in increasing local economic resilience by up to 30% through innovations such as digital promotion and community training (Suryani & Wahyuni, 2022: 102). This evaluation will also highlight potential risks, such as dependence on external actors, to ensure realistic and measurable recommendations.

Third, formulate specific policy recommendations that can be implemented by the Serang Regency Government to optimize the Pentahelix collaboration model within the framework of Village SDGs. These recommendations will be formulated based on a synthesis of analysis and evaluation, covering operational steps such as the formation of a Pentahelix Task Force at the sub-district level, the allocation of at least 12% of Village Funds for digital innovation programs, and the integration of SDG indicators into the 2025-2045 Serang RPJMD. Special focus is given to local adaptation, such as the development of agro-ecotourism in Cadasari Village through a partnership between Untirta and business actors, which is expected to replicate the success of similar programs in other areas of Banten. This policy is in line with national directives that emphasize *multi-stakeholder* collaboration for specific village potential mapping, so that development is not forced but tailored to the strengths of each region, as recommended in the synergy between the Ministry of Villages, Disadvantaged Regions, and Transmigration (Kemendes PDTT) and the Serang Regency Government for 326 villages (Ministry of Villages, Disadvantaged Regions, and Transmigration [Kemendes PDTT], 2025: 3). In addition, the recommendations will include an *e-real-time* data-based monitoring mechanism through *the* SID *platform*, with a target of 80% of villages developing by 2030, as outlined in the 2025 Village SDGs Data Collection Decree, which emphasizes systematic data collection for effective development strategies (Kemendes PDTT, 2023: 6).

Overall, these objectives aim to produce an *actionable* policy *framework* that not only accelerates sustainable village development in Serang Regency but also contributes to national SDG targets through the replication of the Pentahelix model. Thus, this research is expected to be a catalyst for systemic transformation, so that innovative collaboration becomes the main foundation for inclusive and resilient village community welfare.

Benefits of the Study

This study provides essential added value for various parties involved in the village development ecosystem in Serang Regency, with an emphasis on practical application and long-term impact. First, the study provides concrete operational guidelines for local governments, academic institutions, and business actors to implement the Pentahelix

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collaboration model in community empowerment programs. For local governments such as the Serang Community and Village Empowerment Agency (DPMD), these recommendations include tactical steps such as establishing cross-sector coordination forums and allocating a special budget for digital training, which can be directly integrated into the annual Local Government Work Plan (RKPD). Academics, particularly from Sultan Ageng Tirtayasa University (Untirta), will obtain an analytical framework for further research, including metrics for evaluating the impact of Pentahelix synergy on the independent village index (IDM). while local businesses such as agricultural cooperatives can use this guide to develop strategic partnerships, for example through technology-based BUMDes incubators for the diversification of organic products in the southern Serang region. This approach has proven effective in overcoming the limitations of single resources, where Pentahelix collaboration in Toba *Geopark* has successfully integrated academics, businesses, communities, government, and the media to reduce SDG constraints such as infrastructure and community participation by up to 35% (Siregar et al., 2025: 102).

Second, the study supports the potential replication of innovative collaboration models to similar regions in Banten Province and beyond, such as Pandeglang or Lebak districts, which face similar agrarian challenges and spatial disparities. By providing an adaptive *blueprint*, including a template *for a* digital SDG monitoring *platform* for villages and an application-based mutual assistance mechanism, this model can be adapted to local contexts without requiring large initial investments. This replication not only accelerates the dissemination of best practices but also builds inter-regional networks for knowledge exchange, as seen in the Pentahelix strategy for tourism village development in North Bogor, where *multi-stakeholder* synergy resulted in a 28% increase in community income and can be applied to coastal villages in Serang for mangrove ecotourism (Pugra et al., 2021: 115). These benefits strengthen regional resilience to economic disruption, ensuring that innovation is not isolated in one location but becomes a shared asset for sustainable development.

Third, the study contributes significantly to the achievement of Indonesia's 2045 Golden Indonesia national target through the strengthening of independent villages as the main pillar of transformation. By focusing on accelerating IDM and integrating the 18 SDGs for villages, the results of this study support the national vision in which 10,000 independent villages are a key indicator of the success of the 2025-2045 RPJPN, where village development based on self-reliance is recognized as the main foundation for macro welfare through the optimization of targeted Village Funds (Ministry of Villages, Disadvantaged Regions, and Transmigration [Kemendes PDTT], 2021: 2). Specifically, this contribution includes increasing the efficiency of national programs such as the Nusantara Tourism Village Competition, where Pentahelix collaboration can be replicated to support the target of zero village poverty and inclusive economic growth, as emphasized in the Kemendes PDTT policy which makes independent villages the main pillar of the 100-year independence vision (Kemendes PDTT, 2023: 5). Ultimately, this study provides not only tactical benefits for local actors but also strategic benefits for the national agenda, ensuring that Serang Regency becomes a pioneering model for *resilient* villages that support sustainable welfare for 74,961 villages in Indonesia.

II. Theoretical and Literature Review

A. The Concept of Community Empowerment

The concept of community empowerment refers to a series of systematic efforts aimed at building the internal strength of social groups through joint capacity building, whereby individuals and communities gain broader access to information, material assets, and

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opportunities for direct involvement in decision-making. In the context of village development, this process involves a transformation from external dependence to collective independence, where local knowledge is utilized to identify sustainable endogenous solutions. This definition emphasizes a holistic dimension, covering cognitive (increased insight), instrumental (access to resources), and relational (active participation) aspects, so that communities are not merely beneficiaries, but the main architects of socio-economic change in their regions. This approach is in line with the national policy vision that views empowerment as the main foundation for rural welfare, where increasing knowledge and skills are prerequisites for developing an independent attitude and innovative behavior in managing village potential (Ministry of Villages, Disadvantaged Regions, and Transmigration [Kemendes PDTT], 2025: 1).

The evolution of the concept of community empowerment in Indonesia reflects a paradigm shift from a *top-down* model, which was dominant during the New Order era with an emphasis on central instructions and vertical aid distribution, to a more inclusive bottom-up approach since the 1998 Reformation era. In the early stages, the *top-down* approach often resulted in structural dependency, where village development programs were designed by the central bureaucracy without considering local dynamics, resulting in low sustainability and limited community participation in execution. The transition to bottom-up began with Law No. 6 of 2014 on Villages, which promotes village autonomy through participatory deliberation and the allocation of Village Funds as a catalyst for local initiatives. This evolution has been further strengthened by the integration of Village SDGs since 2020, where the bottom-up approach places the community at the center of planning, with a focus on identifying local assets to address disparities such as those seen in agrarian-industrial transition areas. Recent studies show that this shift has successfully increased the level of village independence by 22% in West Java, through mechanisms that combine national directives with *grassroots* initiatives, although coordination challenges between levels of government still require adjustment (Wijaya & Santoso, 2025: 125).

In Indonesia, gotong royong (mutual assistance) has emerged as an authentic cultural element that forms the foundation of the evolution of a bottom-up approach, in which the values of collective cooperation inherited from pre-colonial agrarian traditions have been adapted into modern instruments of empowerment. Gotong royong is not merely a physical activity such as the self-help construction of village infrastructure, but rather a philosophical principle that encourages social solidarity to overcome individual limitations, such as in the joint management of natural resources in coastal villages. In the contemporary context, this concept has been integrated into national programs such as the Advanced Village Movement, where gotong royong is facilitated through deliberative forums to design sustainable solutions, such as communal waste management in tourist villages. Empirical research in South Sulawesi confirms that the application of gotong royong in community-based empowerment increases community participation by up to 45%, with positive impacts on social cohesion and local economic resilience, especially when combined with skills training to overcome the evolution of *top-down* dependency (Nugraha & Sulistyowati, 2023: 5). This evolution makes mutual cooperation a bridge between cultural heritage and the global SDGs agenda, ensuring that empowerment remains relevant to Indonesia's identity while supporting sustainable transformation.

B. Innovative Collaboration

The Pentahelix framework represents an evolution from traditional collaboration models such as the Triple Helix, with an expansion to five key actors—government as regulator and

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facilitator, academia as provider of knowledge and research, business as injector of capital and markets, community as owner of local resources, and media as amplifier of communication and advocacy—to create dynamic synergies in driving development innovation. This model functions as an integrative mechanism that enables the exchange of resources between parties, where each element contributes complementarily to address complex issues such as economic inequality at the village level. In the Indonesian context, Pentahelix is adapted for village development through structured cross-sectoral engagement, such as the establishment of joint forums for identifying potential strengths, which facilitate endogenous innovation such as the development of digital-based agrotourism in agricultural areas. This approach emphasizes an iterative cycle: joint problem identification, co-creation of solutions, collaborative implementation, and participatory evaluation, so that innovation is not fragmented but becomes a sustainable collective outcome (Sari et al., 2024: 45).

The role of digital technology in *the* Pentahelix *framework* is crucial as *an enabler* that accelerates information flow and access to resources, transforming traditional limitations such as geographical distance and communication costs into opportunities for connectivity. Applications such as AI-based monitoring *platforms* or *online* marketplaces enable village communities to interact *in real time* with businesses for the marketing of local products, while academics can provide analytical data for the optimization of government policies. In Indonesian villages, this digital integration has been proven to increase collaboration efficiency by up to 30%, for example through *e-governance* that facilitates virtual deliberations and transparent tracking of Village Funds, thereby reducing corruption and increasing accountability (Hidayat & Rahman, 2025: 210). Technology also supports inclusion, where social media is used for advocacy campaigns, ensuring that the voices of marginalized communities are heard in the innovation process.

Cross-sector partnerships in the Pentahelix are specifically designed to overcome the resource constraints often experienced by villages, such as a lack of financial capital or technical expertise, through *the pooling* of *assets* from various actors. The government provides regulations and basic infrastructure, academics offer research and training, businesses provide investment and supply chains, communities contribute contextual knowledge, and the media ensures visibility to attract external support. This partnership creates a multiplier effect, where the limitations of one party are compensated by the strengths of another, as in the smart village program in West Java that integrates IoT for precision agriculture through collaboration between universities and the private sector, resulting in a 25% increase in productivity without burdening the village budget (Wahyudi et al., 2025: 67). National policy documents increasingly support this model by targeting partnerships for the achievement of Village SDGs, where cross-sectoral synergy is a key requirement for innovative and inclusive Village Fund allocation (Ministry of Villages, Disadvantaged Regions, and Transmigration [Kemendes PDTT], 2023: 4).

C. Sustainable Village Development

Sustainable village development is defined as an integrated transformation process that balances economic progress, social cohesion, and environmental preservation, with the aim of creating long-term resilience for rural communities. In the Indonesian context, this integration is realized through the alignment of these principles with the 18 Village SDGs, which include elements such as the elimination of local poverty (goal 1), improved access to education and health (goals 3-4), and responsible management of natural resources (goals 12-15). This holistic approach ensures that development does not only focus on village GDP growth, but

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also on equitable social access, such as women's participation in decision-making (goal 5) and reducing regional disparities (goal 10), while preserving ecosystems such as coastal mangrove forests through *agroforestry* practices. This integration creates a positive cycle in which economic progress supports social investment, which in turn protects the environment, enabling villages to withstand disruptions such as floods or fluctuations in the agricultural commodity market (Hakim & Hanif, 2025: 33).

The local adaptation of the global SDG agenda is a hallmark of village development in Indonesia, where the 17 UN goals have been transformed into 18 more contextual and operational priorities, such as the addition of a dynamic village institutional goal to accommodate cultural dynamics and local autonomy. This adaptation process began in 2020 through national policies that emphasized adjusting indicators to village conditions, for example, changing SDG 7 (affordable energy) to focus on communal solar energy in remote villages, or SDG 11 (sustainable cities) to disaster-resilient village settlement management. This adaptation allows villages to prioritize endogenous issues such as food security in agricultural areas, while still contributing to national targets such as a 29% reduction in carbon emissions by 2030. Research shows that this local adaptation increases the relevance of the program by up to 40%, as it involves village deliberations to adjust targets to potential opportunities such as marine tourism on the coast, rather than rigidly applying a global formula (Sarmadan & Kasim, 2025: 45).

The Village Fund's priorities in this adaptation are focused on green infrastructure and inclusive economy as the main pillars, where the national budget allocation of Rp 70 trillion in 2025 is allocated for projects such as IoT-based drip irrigation and the development of export-oriented BUMDes. Green infrastructure, such as the construction of environmentally friendly roads and rainwater management systems, supports SDGs 6 (clean water) and 13 (climate action), while the inclusive economy targets the empowerment of women and youth MSMEs to reduce structural poverty. This policy ensures that the Village Fund not only builds physical assets but also creates an inclusive ecosystem where 30% of the budget is allocated for entrepreneurship training, thereby supporting goal 8 (decent work) through partnerships with the private sector for digital markets (Ministry of Villages, Disadvantaged Regions, and Transmigration [Kemendes PDTT], 2020: 6). Recent literature highlights that this priority has accelerated village self-reliance in Central Java, with an 18% increase in village GRDP through green-inclusive integration, although it requires strengthened monitoring to avoid deviations (Iskandar, 2020: 56).

D. Current Empirical Studies

A synthesis of recent empirical studies highlights the practical application of innovative collaboration in sustainable village development in Serang Regency, focusing on case studies that integrate Pentahelix to address local issues such as waste management and economic resilience. The KAMI BERSEMI (Innovative, Clean, Prosperous, and Independent Village) program in Serang Regency is a successful example of Pentahelix collaboration for waste management and MSME development, where the local government, academics from Sultan Ageng Tirtayasa University (Untirta), local businesses such as PT PLN, community members, and local media work together to build a digital-based waste bank. This initiative, launched through Serang Regent Circular Letter No. 3 of 2024, has generated an economic circulation of IDR 53 million per month from recycling waste into saleable products, while reducing household waste volume by up to 40% in 50 participating villages. Empirical studies show that this partnership model not only increases environmental awareness but also creates inclusive

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employment opportunities for women and youth, aligning with SDG 12 (responsible consumption) and SDG 8 (decent work), with a sustainability rate of 75% post-implementation (Akhmad, 2025: 12).

The second case study, strengthening the Village-Owned Enterprise (BUMDes) in Pejaten Village, Kramatwatu District, through innovative training, illustrates how cross-sector knowledge transfer can revitalize village economic institutions. Collaboration between the subdistrict government, lecturers from Universitas Persada Indonesia YAI (UPI YAI), and local MSME cooperatives resulted in a financial management and digital marketing training program during 2022-2023, which increased BUMDes' turnover from IDR 150 million to IDR 320 million per year. This approach emphasizes case-based training, such as integrating *e-commerce* for local horticultural products, addressing market access limitations in the agricultural area of Kramatwatu. Empirical results indicate a 60% increase in the capacity of BUMDes managers, with a social impact of employing 25 villagers, supporting SDG 1 (no poverty) through sustainable business diversification (Samosir et al., 2025: 338).

Meanwhile, the digital village initiative in Baros Village, Baros District, stands out as a model for mitigating economic and social needs through technology-based transformation. Through *Focus Group Discussions* (FGD) facilitated by a team of lecturers from the Faculty of Social and Political Sciences, Veteran National Development University Jakarta (FISIP UPNVJ) in 2023-2024, this program integrates digital *platforms* for marketing economic potential such as handicrafts and plastic waste management based on a circular economy. This Pentahelix collaboration, involving the village government, academics, youth community groups, the National Veterans' Development University ( ), and digital media, successfully reduced information access gaps by 50% and increased household income by 20% through a local *marketplace* application. Empirical studies emphasize that this mitigation is effective in addressing the pandemic's impact on the informal sector, with a 35% increase in social participation through *e-musrenbang,* aligning with SDG 9 (innovative infrastructure) and SDG 10 (reduce inequality) (Tasari, 2024: 2584).

The synthesis of these three case studies underscores that Pentahelix collaboration in Serang not only produced operational innovations but also built systemic resilience, with an average increase in village IDM of 18-25% post-intervention. However, challenges such as low digital literacy require continuous adaptation for wider replication.

2. RESEARCH METHOD

A. Approach

This study adopts a descriptive qualitative design oriented towards in-depth exploration of the phenomenon of innovative collaboration in rural community empowerment, with an emphasis on narrative description and contextual interpretation to reveal patterns and policy implications. This approach was chosen for its ability to capture the nuances of complex *multi-stakeholder* dynamics at the local level, without relying on rigid quantitative measurements, making it suitable for analyzing the adaptation of Village SDGs within the framework of sustainable development. A systematic literature review is the core method, in which sources are selected gradually to build a coherent argument, while policy document analysis complements this with verification of national and regional policies. This approach is in line with current practices in village development studies, where descriptive qualitative design allows for the synthesis of secondary findings to produce contextual recommendations, as

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applied in the evaluation of village policies in East Java, which combines *literature review* with RPJMD documents to identify implementation *gaps* (Wibowo et al., 2025: 2).

B. Data Sources

The research data is entirely secondary, sourced from Scopus Q1 and SINTA 2 indexed academic journal publications from 2020-2025 discussing Pentahelix collaboration and Village SDGs, regional planning documents such as the 2024 Serang Regency Local Government Work Plan (RKPD), official reports from the Ministry of Villages, Disadvantaged Regions, and Transmigration (Kemendes PDTT) on the achievement of Village SDGs, as well as local case studies such as the Community Service Program (PKM) of Pamulang University (Unpam) in Serang and the National Seminar on Community Service (SENMASTER) of the Open University (UT). These sources were selected to ensure depth of analysis, with journals providing empirical findings, policy documents providing a regulatory framework, and case studies offering practical illustrations. For example, the 2024 Serang RKPD includes SDG-based village development priorities, while the 2024 Kemendes PDTT report summarizes national indicators for verification (Serang Regency Government, 2024: 19; Kemendes PDTT, 2024: 22). The Unpam PKM case study focuses on capacity building for innovative village officials in Serang (Unpam PKM Team, 2025), while SENMASTER UT highlights the mentoring of 63 villages in Banten for sustainable MSMEs (Open University, 2025: 5).

C. Data Collection Techniques

Data collection was conducted through a structured and systematic search process to maximize coverage and relevance, beginning with the identification of keywords such as "Pentahelix collaboration SDGs Serang Village" and "innovative community empowerment Banten 2020-2025" in academic databases such as Google Scholar, as well as the official government website , including the Serang Regency JDIH and the Kemendes PDTT portal. Strict inclusion criteria were applied, namely publications published in 2020-2025, direct relevance to Serang Regency or a similar context, full accessibility, and quality (Scopus Q1/SINTA 2 for journals, official documents for policies). From around 300 initial results, 45 primary sources were filtered using management tools such as Zotero to avoid duplication and prioritize recency. This technique ensures up-to-date data, such as the 2024 RKPD report accessed through the official portal for village priority analysis (Serang District Government, 2024). This process also includes verifying case studies through additional searches in university repositories, such as PKM Unpam documented in the 2025 community service report (PKM Unpam Team, 2025).

D. Data Analysis

Data analysis integrates content analysis to identify patterns of collaboration in documents and literature, where texts are coded thematically to reveal the frequency and relationships between Pentahelix actors, such as the synergy between academics and businesses in strengthening BUMDes. This approach is complemented by *thematic analysis* to explore key themes of innovation (e.g., digital adoption in villages) and sustainability (e.g., integration of SDG 13 climate action), with code grouping into coherent narratives using NVivo for pattern visualization. This technique allows for in-depth interpretation, where collaboration patterns are evaluated against SDG impacts, such as a 30% increase in participation through digital *platforms*. A similar analysis was applied in a study of SDGs in Indonesian villages, where content analysis of policy documents was combined with *a thematic review* to reveal implementation challenges (Hakim & Hanif, 2025: 32).

E. Validity and Ethics

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The validity of the research is maintained through source triangulation, where findings from journals are validated with policy documents and case studies to reduce bias and increase reliability, such as comparing the Kemendes PDTT report with Serang RKPD data for SDG indicator consistency. Ethics are upheld by respecting copyright through accurate citations and source attribution, avoiding plagiarism, and ensuring the accessibility of public data without violating privacy. This protocol is in line with qualitative research ethics standards, where triangulation ensures the credibility of findings (Creswell & Poth, 2023: 258).

3. RESULT AND DISCUSSION

IV. Discussion

A. Overview of Serang District

Serang Regency, as a crucial region in Banten Province, presents a multidimensional profile that reflects both its potential and vulnerabilities in the dynamics of sustainable village development. With a vision of transformation towards an autonomous and adaptive region, this overview serves as the basis for integrating Pentahelix collaboration in the adaptation of Village SDGs, where local challenges such as spatial inequality can be overcome through the synergy of multi-sector actors.

1. Geographical and Administrative Profile

Serang Regency covers an area of 1,734 km², which is divided into 28 sub-districts, 326 villages, and 12 urban villages, making it a vast and diverse administrative entity at the western tip of Java Island. Its strategic location as the main link between Jakarta and international ports makes it a vital buffer for the Greater Jakarta metropolitan area, with easy access to the Sunda Strait for maritime trade. Its natural potential is abundant, including a 60 km coastline that supports ecotourism, a 5,000-hectare mangrove forest area for biodiversity conservation, and mineral reserves such as iron sand and andesite that can be exploited sustainably. This administrative structure facilitates village autonomy through the 2014 Village Law (Undang- , where 326 villages serve as the basic units for SDG implementation, although the varied topography from coastal plains to volcanic hills necessitates local adaptation in planning (Serang Regency Government, 2025: 12).

2. Demographics

The population projection for Serang Regency in 2025 is 1.65 million, with a composition dominated by the productive age group at around 60%, reflecting a potential demographic bonus to drive rural economic growth. The average population density of 952 people per km² is highest in the northern zone due to industrial worker migration, while life expectancy of 72 years and a literacy rate of 95% indicate basic progress. However, key challenges include the prevalence of stunting in children reaching 18% in rural villages, which hinders the quality of human resources, and women's participation in the economic sector at only 35%, especially in the southern agricultural region. This situation emphasizes the urgency of inclusive empowerment through the SDGs Village program, goal 4 (quality education) and goal 5 (gender equality), where collaboration with academics can accelerate nutritional and vocational interventions (Serang Regency Central Statistics Agency, 2025: 25).

3. Economy

The economic structure of Serang Regency is driven by the manufacturing sector, which contributes 40% to the Gross Regional Domestic Product (GRDP), followed by agriculture at 25% and tourism-services at 20%, with a growth rate of 4.78% in 2024, which is projected to remain stable in 2025. Key potentials such as rice agribusiness in the south and chemical

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industry clusters in the north support diversification, but dependence on mineral extraction is vulnerable to global volatility. The target of Rp 80 million per capita GRDP by 2045 will be achieved through digitalization strategies, such as the development *of e-marketplaces* for village MSME products and app-based ecotourism, which are in line with SDG 8 (inclusive economic growth). Empirical studies show that this digital integration can increase the contribution of villages to GRDP by up to 15%, mainly through Pentahelix partnerships for *agrotech* innovation (Yusfi et al., 2024: 118).

4. Infrastructure

Serang Regency's connectivity is strengthened by key infrastructure such as the Jakarta-Merak Toll Road and Merak Port, which connect to the national logistics network, supporting a flow of goods of up to 10 million tons per year. Electricity coverage reaches 98% of the region, with 70% internet penetration facilitating digital villages, while clean water access is at 85%. However, sanitation in rural areas is only at 60%, especially in remote sub-districts, which hinders SDG goal 6 (clean water and sanitation). Green infrastructure investments, such as fiber optic networks for 100% digital coverage by 2030, are a priority to reduce disparities, with projected spending of Rp 50 trillion by 2045 through the Village Fund and CSR (Serang Regency Government, 2025: 45).

5. Challenges

Serang Regency faces major threats such as tidal flooding that inundates 20% of the coastal area due to sea level rise, land degradation from illegal mining that affects 15% of agrarian villages, and spatial disparities between the northern industrial corridor (6.8% poverty) and the southern farming zone (16.4%). Social issues such as land conflicts and uncontrolled urbanization exacerbate disparities, with rural poverty at 11.2% in 2024. The 2025-2045 RPJPD vision targets innovation-based development through Pentahelix collaboration for risk mitigation, such as mangrove reforestation programs and disaster monitoring *platforms*, to achieve a human development index of 80 points by 2045 (Serang Regency Government, 2025: 52). The gap study confirms that this local adaptation of the is crucial to reducing *the* urban-rural *gap* by 20% (Pratama & Sari, 2025: 5).

B. Analysis of Innovative Collaboration in Serang Regency

The analysis of innovative collaboration in Serang Regency emphasizes the application of *the* Pentahelix *framework* as a tool for transformation to integrate cross-sector actors in village empowerment, with a focus on contextual SDG adaptation in villages. Through the synthesis of local initiatives, it is evident that this synergy not only overcomes resource constraints but also accelerates village independence through endogenous innovation, although institutional strengthening is required for scalability.

1. The Pentahelix Model in Practice

The Pentahelix model is effectively implemented through the KAMI BERSEMI (Innovative, Clean, Prosperous, and Independent Village) initiative, which involves PT PLN as a business partner, the Serang local government, academics from Sultan Ageng Tirtayasa University (Untirta), community members, and local media for innovative waste management. This program, launched through Regent Circular Letter No. 3 of 2024, established a mobile app-based waste bank for recycling, generating an economic circulation of IDR 53 million per month from the sale of *recycled* products such as bags made from plastic waste, while achieving the *zero-waste* target in 50 participating villages. This collaboration demonstrates how the media's role in digital campaigns strengthens advocacy, while Untirta provides technological

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research, thereby reducing waste volume by 40% and creating 200 informal jobs, in line with the Pentahelix synergy principle for inclusive development (Akhmad, 2025: 12).

2. Empowerment Program

The empowerment program through Community Service (PKM) by Pamulang University (Unpam) in Pejaten Village, Kramatwatu District, highlights the capacity building of village officials through innovative digital gamification-based training, involving collaboration with the district government and local communities for BUMDes management. Additionally, BUMDes strengthening is carried out through workshops at universities such as UPI YAI, which integrate accounting and *online* marketing skills, increasing village business turnover by 113% from IDR 150 million to IDR 320 million annually. In Baros Village, the digital village initiative utilizes participatory *Focus Group Discussions* (FGD) for e-government and handicraft product marketing, where *online platforms* facilitate market access for 150 households, reducing the information gap by 50% through integration with the SID (Village Information System) application. These programs emphasize the role of academics in knowledge transfer, with an impact on increasing social participation by 35% (Samosir et al., 2025: 338; Tasari, 2024: 2584).

3. Impact on Village SDGs

This innovative collaboration contributes significantly to Village SDGs, with an 18.71% increase in the independent village index in 2024 in 120 villages in Serang, driven by the integration of technologies such as TEMAN VINTER – *a* virtual *platform* for settlement monitoring – which supports SDG 11 (sustainable settlements) through tidal flood mapping and SDG 13 (climate action) via weather adaptation simulations. Additionally, a 4.08% reduction in village poverty was achieved through MSME diversification, where Pentahelix partnerships ensured the allocation of 20% of Village Funds for green innovation. This impact is measurable through the Kemendes PDTT report, in which Serang recorded the highest progress in Banten for goals 1 (no poverty) and 8 (decent work), with a 25% increase in economic resilience post-pandemic (Ministry of Villages, Development of Disadvantaged Regions, and Transmigration [Kemendes PDTT], 2025: 22).

4. Case Study

A case study of youth collaboration in Serang Village shows the role of the younger generation in sustainable planning, where the Karang Taruna group worked with the village government and Untirta to develop a Village Medium-Term Development Plan (RPJMDes) based on SDGs, resulting in a communal reforestation program that absorbs 200 tons of CO2 annually and creates eco-jobs for 50 young people. Meanwhile, the Open University (UT) National Community Service Seminar (SENMASTER) program has fostered 63 villages in Banten, including Serang, for MSME development and innovations such as organic product *traceability* applications, which have increased village exports by 30% through partnerships with national *e-commerce platforms*. These cases illustrate the scalability of the Pentahelix model, with a 40% increase in youth participation as a key to sustainability (Open University, 2025: 5; Widodo, 2024: 150).

C. Challenges and Obstacles

Although the innovative Pentahelix collaboration promises to accelerate sustainable village development in Serang District, its implementation faces a series of interrelated internal and external challenges, as well as systemic risks that require strategic mitigation. This analysis outlines these obstacles based on the local context, where cultural, technological, and

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environmental factors complicate the adaptation of Village SDGs, while highlighting potential solutions through actor synergy.

1. Internal Issues

Key internal issues include low digital literacy among rural communities, which will only reach 42% in 2024, hindering the adoption of SDG monitoring *platforms* and *e-marketplaces* for village MSMEs. Cultural resistance to innovation is also a barrier, where traditional values of mutual cooperation often clash with modern technological approaches, causing skepticism towards digital training in 60% of agrarian villages. In addition, fluctuations in Village Funds due to national budget uncertainty—from IDR 70 trillion in 2024 to a projected IDR 65 trillion in 2025—disrupt program continuity, with 25% of villages in Serang experiencing a 15% decrease in allocation. This situation weakens the capacity of village institutions, such as BUMDes, which depend on stable funding for green innovation (Serang Regency Government, 2025: 47).

2. External Issues

At the external level, coordination between stakeholders remains weak, with only 35% of Pentahelix forums in Serang operating regularly, due to the lack of formal mechanisms such as cross-sector MoUs, so that initiatives such as KAMI BERSEMI are limited to sporadic projects. The impact of climate change, particularly tidal flooding affecting 20% of the northern coastal area, further exacerbates village resilience, with economic losses of IDR 50 billion per year and disruption to SDG 13 (climate action). Dependence on private *Corporate Social Responsibility* (CSR), which contributes 20% of village funding, creates uncertainty as corporate priorities often change, such as the decline in contributions from the Cilegon chemical industry after the pandemic (Ministry of Environment and Forestry [KLHK], 2023: 34). Empirical studies show that this weak coordination reduces the effectiveness of CSR by up to 40% in industrial buffer zones (Deviastri & Annisa, 2022: 8).

3. Risk Analysis

Risk analysis highlights gender and access disparities, where women's participation in empowerment programs is only 35%, especially in southern villages, which exacerbates the SDG 5 (gender equality) gap and limits the inclusive impact of digital innovation. Potential land conflicts from industrial expansion, such as the factory project in Anyer that affects 10% of the village's agricultural land, risk triggering social disputes and ecosystem degradation, with a projected 25% increase in conflict cases by 2030. These risks can be mitigated through Pentahelix mediation, but without strong regulations, they could hinder the target of self-sufficient villages (Ministry of Women's Empowerment and Child Protection [KemenPPPA], 2024: 15). Disparity studies confirm that gender-sensitive interventions are needed to reduce access risks by up to 30% in agrarian-industrial transition villages (Sari & Putra, 2024: 145).

4. CONCLUSION

1. Summary of Key Findings

This study concludes that innovative Pentahelix-based collaboration is the main catalyst in accelerating sustainable village development in Serang Regency. The synergy between the local government, academics (such as Untirta and Unpam), business actors (PT PLN and MSMEs), community members, and the media has proven capable of overcoming local resource constraints through various initiatives, ranging from the KAMI BERSEMI program, which has resulted in a circular waste economy, to the strengthening of digital BUMDes in Kramatwatu and Baros. This collaboration has not only increased the Village Development

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Index by 18.71% and reduced the village poverty rate by 4.08% in the 2023–2025 period, but also strengthened socio-economic resilience amid complex geographical and demographic challenges (Ministry of Villages, Development of Disadvantaged Regions, and Transmigration [Kemendes PDTT], 2025,: 22). The findings confirm that Pentahelix is not merely a theoretical framework, but an effective operational model for integrating technological innovation, academic knowledge, and local wisdom into a single development ecosystem (Saskara et al., 2024: 14).

2. Implications

The results of this study have strategic implications at both the regional and national levels. In Serang Regency, the success of the Pentahelix model proves that the 2025–2045 RPJPD vision of becoming an "advanced region based on innovation and sustainability" can be achieved more quickly through a collaborative approach, particularly in reducing spatial disparities between the industrial north and the agricultural south. At the national level, Serang's experience enriches the targets for achieving the 18 SDGs for Villages and the Indonesia Emas 2045 vision, particularly in terms of accelerating the status of independent villages, which is targeted to reach 10,000 villages by 2030. This contribution also strengthens the position of the Village Fund as an inclusive instrument capable of supporting the global SDGs agenda through measurable and participatory local adaptation (Serang Regency Government, 2025: 68; Kemendes PDTT, 2023: 5).

4. Recommendations for Further Research

To deepen understanding, further research using a mixed-methods approach combining large-scale quantitative surveys (at least 300 villages in Banten) with in-depth interviews with Pentahelix actors is recommended to evaluate the long-term impact (5–10 years) on Village SDG indicators, particularly SDGs 1, 8, and 13. Longitudinal research is also needed to measure the sustainability of the program after the end of external support, as well as to develop a Pentahelix collaboration index that can be replicated in other districts (Wibowo et al., 2025: 12). Overall, Serang District has demonstrated that innovative Pentahelix collaboration is no longer an option but a necessity to achieve self-reliant, inclusive, and *resilient* villages toward Indonesia Emas 2045.

B. Policy Recommendations

These policy recommendations are designed as an *actionable* guide to optimize Pentahelix collaboration in accelerating Village SDGs in Serang District, with a phased approach that is in line with the 2025-2045 RPJPD and the national priorities of the Village Fund. The main focus is on budget efficiency, institutional strengthening, and scalability, where short-term strategies target rapid intervention, long-term strategies build structural foundations, and replication ensures the spread of benefits to wider areas.

1. Short-Term Strategy

The short-term strategy focuses on optimizing existing resources for quick results, including allocating a minimum of 15% of the Village Fund (approximately IDR 10.5 billion from a total of IDR 70 billion annually) for the development of collaborative digital *platforms* such as AI-based SDG monitoring applications integrated with SID, enabling *real-time* participatory *e-reporting* between Pentahelix actors. In addition, annual training for 1,000 village cadres through Sultan Ageng Tirtayasa University (Untirta) should be mandatory, with a curriculum covering digital literacy and BUMDes management, to increase the capacity of village officials by 50% within one year. This approach is supported by national policies that encourage the prioritization of Village Funds for inclusive innovation, where a similar

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allocation in Central Java has succeeded in accelerating the achievement of SDG 9 (innovative infrastructure) by 20% through *a* similar *platform* (Ministry of Villages, Disadvantaged Regions, and Transmigration [Kemendes PDTT], 2023: 4).

2. Long-Term Strategy

For the 5-10 year horizon, the formation of a Pentahelix Task Force at the district level is imperative, with a mandate for monthly coordination involving representatives from the government, Untirta, local businesses, communities, and the media, to ensure sustainable synergy in the Serang RPJMD. Revision of Regional Regulation (Perda) Number 8 of 2025 is necessary to include the mandate for village innovation, such as tax incentives for digital BUMDes and the integration of SDGs as criteria for evaluating village head performance. Annual monitoring based on the Village Development Index (IDM) and SDG indicators must be implemented through an integrated dashboard, with a target of a 25% increase in IDM by 2030. This strategy is in line with national guidelines emphasizing the revision of regional planning for SDG adaptation, where data-based monitoring has been proven to reduce regional disparities by up to 15% in similar provinces (Sarmadan & Kasim, 2025: 45).

3. Replication

Replication of the KAMI BERSEMI model must be expanded to 100 priority villages in Serang District, from the northern coast to the southern agricultural areas, with contextual adaptations such as the integration of agricultural waste management for *zero waste*, which is projected to create 5,000 informal jobs within three years. Partnerships with the Open University (UT) for MSME development can be strengthened through the SENMASTER program, in which 63 villages in Banten are used as pilots for *e-commerce* and product *traceability* training, increasing MSME exports by 30%. This approach supports the national policy of university-village partnerships, where the replication of a similar model in Pandeglang has succeeded in strengthening the blue economy through integrated management of coastal MSMEs (Pamulang University Serang Campus, 2025: 5; Kemendes PDTT, 2024: 18).

These recommendations are expected to serve as *a blueprint* for Serang's transformation, with annual evaluations for adjustments, ensuring maximum contribution to the Indonesia Emas 2045 vision through innovative and inclusive villages.

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