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Social-ecological transformation of former illegal gold miners through the Cisangku conservation village model

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ABSTRACT

Illegal Gold Mining (IGM) represents a complex social-ecological issue that contributes to environmental degradation, social vulnerability, and unsustainable community livelihoods. This study aims to analyze the process of social-ecological transformation among former illegal gold miners through the Cisangku Conservation Village Model (CVM) in the buffer zone of Gunung Halimun Salak National Park. A qualitative approach with a descriptive research design was employed. Data were collected through in-depth interviews, field observations, and document analysis. Data analysis involved data reduction, data presentation, and conclusion drawing, with validity ensured through source, method, and time triangulation. The findings indicate that the Cisangku Conservation Village Model has facilitated social-ecological transformation by shifting community livelihoods from illegal gold mining to conservation-based economic activities, including traditional ground coffee production, endemic plant seedling nurseries, and conservation-based ecotourism. These livelihood transitions increased the average income of members by 42%, expanded employment opportunities for vulnerable groups, engaged 69% of former illegal miners in conservation activities, and supported environmental rehabilitation through the planting of 356,000 trees. The transformation process was driven by collaboration among government agencies, the private sector, local communities, and the leadership of a local hero, which strengthened community participation and promoted behavioral change. The study concludes that conservation-based community empowerment is an effective strategy for achieving social-ecological transformation, strengthening sustainable livelihoods, and supporting sustainable development.

INTRODUCTION

Illegal Gold Mining (IGM) remains one of the most complex social-ecological challenges in Indonesia (Kaya, 2026; Torres, 2026). Social-ecological transformation requires fundamental changes in social structures, economic systems, human-nature relationships, and the values that underpin development (Adloff & Neckel, 2021). Illegal gold mining not only constitutes a violation of mining regulations but also reflects deeper structural problems associated with poverty, limited employment opportunities, inadequate access to productive economic resources, and weak natural

resource governance (Blühdorn et al., 2022; Makwerere et al., 2026).

The use of mercury and other hazardous chemicals in gold processing poses serious risks of contaminating soil, rivers, and groundwater, thereby degrading environmental quality (Xie & Den Hartog, 2026). Furthermore, uncontrolled land clearing associated with illegal mining accelerates deforestation, biodiversity loss, soil erosion, river sedimentation, and the deterioration of watershed functions (Sezek, 2026). To date, society has tended to prioritize individual freedom, while principles such as limiting consumption, regulating resource exploitation, and respecting ecological boundaries

have yet to achieve comparable social legitimacy (Blühdorn, 2022). Consequently, sustainability initiatives continue to face significant challenges because prevailing lifestyles frequently exceed the Earth's ecological carrying capacity. Such environmental degradation not only threatens ecosystem sustainability but also diminishes communities' capacity to utilize natural resources sustainably (Blühdorn et al., 2022). Over the long term, environmental degradation caused by illegal gold mining increases the risk of ecological disasters while weakening the social-ecological resilience of communities surrounding mining areas (Maketho & Thebe, 2025).

Community empowerment has increasingly emerged as a relevant strategy for encouraging behavioral change while creating more sustainable livelihood opportunities. Community empowerment seeks to enhance the capacities of individuals and community groups, strengthen local institutions, expand access to productive resources, and foster collective awareness of environmental conservation (Azumah et al., 2021). This approach views communities not as passive beneficiaries of development but as active agents capable of managing social change independently. Accordingly, the success of community empowerment can be assessed through behavioral change, strengthened social capital, the growth of productive economic activities, and an increased commitment to environmental conservation.

The Cisangku Conservation Village Model (CVM), implemented in the buffer zone of Gunung Halimun Salak National Park, aims not only to rehabilitate degraded environments but also to develop various conservation-based livelihood alternatives, including environmentally friendly agriculture, coffee production, plant nurseries, microenterprises, and other productive economic activities. Through this initiative, former illegal gold miners are encouraged to transition from illegal mining to legal, productive livelihoods while actively participating in environmental conservation (Cosby et al., 2024).

The transformation of livelihoods extends beyond a simple occupational shift. It encompasses fundamental changes in people's mindsets, values, social norms, social relationships, and perceptions of the environment as a vital life-supporting asset (Adloff & Neckel, 2021). Social-ecological

transformation therefore integrates social change with the restoration of ecosystem functions. This study aims to analyze the process of social-ecological transformation among former illegal gold miners through the Cisangku Conservation Village Model. The findings are expected to contribute theoretically to the development of scholarship on social-ecological transformation and sustainable livelihoods, while also providing practical recommendations for governments, private companies, and civil society organizations in designing conservation-based community empowerment programs.

METHODS

This study employed a qualitative approach using a descriptive research design to obtain an in-depth understanding of the social-ecological transformation experienced by former Illegal Gold Mining (IGM) actors through the Cisangku Conservation Village Model (CVM). A qualitative approach was considered appropriate because it enables a comprehensive exploration of participants' experiences, perceptions, and social interactions within their natural context.

The research was conducted in Cisangku Hamlet, Malasari Village, Nanggung District, Bogor Regency, West Java Province, Indonesia. The study site was selected purposively because it is located within the buffer zone of Gunung Halimun Salak National Park (GHSNP). The Cisangku Conservation Village Model was established to facilitate the transition of local communities, particularly former illegal gold miners, from illegal mining activities to legal, productive, and conservation-based livelihoods.

Research participants were selected using purposive sampling, targeting individuals with substantial knowledge, experience, and direct involvement in the implementation of the Conservation Village Model. To enrich the data and capture diverse perspectives, participant recruitment was subsequently expanded using snowball sampling (Yin, 2018).

The participants in this study were purposively selected based on their direct involvement and knowledge of the socio-environmental transformation occurring in the study area. They consisted of former illegal gold miners who had transitioned to alternative livelihoods,

administrators and members of the Cisangku Conservation Village Model, representatives of PT ANTAM UBPE Pongkor, village government officials, managers of Gunung Halimun Salak National Park, and community leaders with extensive knowledge of the social and environmental dynamics of the community. The inclusion of these diverse stakeholder groups enabled the study to capture multiple perspectives on livelihood transformation, community empowerment, environmental conservation, and collaborative governance, thereby providing a comprehensive understanding of the processes and outcomes of the transition from illegal gold mining to sustainable livelihood practices.

The study utilized both primary and secondary data sources. Primary data were collected through in-depth interviews, field observations, and informal discussions with research participants. Semi-structured interviews were conducted using an interview guide developed according to the research objectives, allowing participants to describe their experiences, perceptions, and the transformation processes they had undergone in detail. Field observations were conducted to document community economic activities, environmental conservation practices, interactions among members of the Conservation Village Model, and the implementation of conservation-based livelihood programs. These observations provided contextual insights into how local communities adapted their livelihoods while participating in conservation initiatives. To complement the primary data, secondary data were collected from multiple sources, including documents from PT ANTAM UBPE Pongkor, government reports and official records, community institutional archives, previous research findings, scientific publications, and relevant regulations concerning community empowerment, environmental conservation, and the management of Illegal Gold Mining (IGM). The integration of primary and secondary data strengthened the credibility of the findings through data triangulation and provided a comprehensive understanding of the institutional, social, and environmental context of the study.

The data were analyzed using the interactive qualitative analysis framework developed by Miles (2014), which consists of three interconnected stages: data reduction, data display, and conclusion

drawing and verification. Data reduction involved selecting, simplifying, and organizing relevant information obtained from interviews, observations, and documentary sources. The reduced data were then systematically presented to facilitate interpretation and enable the identification of patterns, relationships, and emerging themes associated with the social-ecological transformation process. The final stage involved drawing conclusions and continuously verifying the findings to ensure that the interpretations accurately reflected the empirical evidence.

To enhance the credibility and trustworthiness of the findings, the study employed three forms of triangulation. Source triangulation was conducted by comparing information obtained from different participant groups, while method triangulation integrated evidence from interviews, field observations, and document analysis. In addition, time triangulation was applied by collecting data at different periods to examine the consistency and stability of the information obtained. The combined application of these triangulation strategies strengthened the validity, reliability, and overall rigor of the qualitative analysis, thereby ensuring that the findings provided a robust and comprehensive understanding of the social-ecological transformation from illegal gold mining to conservation-based livelihoods.

RESULTS AND DISCUSSION

Social conditions before the transformation

Illegal Gold Mining (IGM) refers to mining activities conducted by individuals, community groups, or business entities without obtaining official authorization from the government in accordance with applicable mining regulations. The absence of legal permits places all stages of mining operations from exploration and extraction to ore processing outside the government's regulatory and monitoring framework. Consequently, illegal mining activities generally fail to comply with technical standards, occupational safety requirements, and environmental management principles that constitute the foundation of good mining practices.

In the Cisangku area, Illegal Gold Mining (IGM) operations commonly employed waterwheel-powered ball mills (*gelundung*) installed along riverbanks to process gold ore. During processing,

each ball mill was filled with crushed gold ore, water, mercury (quicksilver), and iron balls or metal fragments that functioned as grinding media (Nuryanty et al., 2024). The milling process typically lasted 5–6 hours, producing gold-bearing concentrate for subsequent extraction.

Approximately 800 ball mills were operated by illegal miners in the area, contributing substantially to environmental degradation. The extensive use of mercury, cyanide, and other hazardous chemicals contaminated the Cikaniki River, as mining waste was generally discharged directly into the river without any prior treatment. This practice generated significant environmental pollution and transferred the resulting environmental and health burdens to the wider community, creating what has been described as socialized risk (Platzek et al., 2026).

Beyond its ecological consequences, Illegal Gold Mining also generated a wide range of social and economic problems (Maketho & Thebe, 2025). Therefore, addressing IGM requires a comprehensive approach that extends beyond law enforcement. Effective intervention should also include community empowerment, the provision of

sustainable alternative livelihoods, and strengthened natural resource governance capable of balancing economic needs, social welfare, and environmental conservation (Makwerere et al., 2026).

The Cisangku conservation village model

The establishment of the Cisangku Conservation Village Model (CVM) originated from a tenure conflict between local communities and the Gunung Halimun Salak National Park Authority (GHSNP Authority). The conflict emerged following the issuance of Minister of Forestry Decree No. 175 of 2003, which expanded the boundaries of Gunung Halimun Salak National Park by converting portions of production forest into protected conservation areas.

This policy significantly restricted local communities' access to land that had long served as their primary source of livelihood, including rice fields, plantations, and cultivated land located within and adjacent to the newly designated conservation area. As a result, tensions arose between the government's conservation objectives and the economic interests of communities whose livelihoods depended heavily on forest resources.

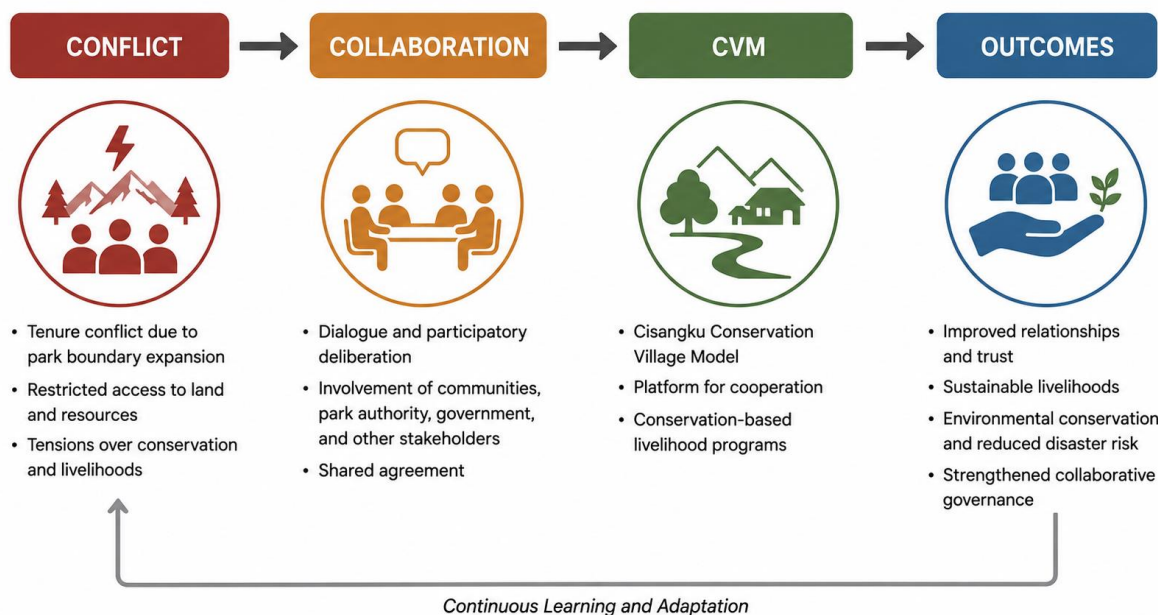


Figure 1. Framework of the Cisangku Conservation Village Model (CVM)

The situation highlighted the urgent need to strengthen community resilience through greater local self-reliance, simplicity, and adaptation to ecological crises (Dannemann et al., 2024). In response, local communities, the Gunung Halimun Salak National Park Authority, village government

officials, and other stakeholders engaged in a series of dialogues and participatory deliberations (Dentoni et al., 2026; Dentoni et al., 2021). These collaborative discussions resulted in a shared agreement to establish the Cisangku Conservation Village Model as a collaborative platform for

fostering more constructive relationships between local communities and conservation authorities (Hussein et al., 2025).

Cisangku Hamlet, located in Malasari Village, Nanggung District, is characterized by steep slopes and hilly terrain, making the area highly susceptible to landslides and soil movement. This vulnerability has been exacerbated by Illegal Gold Mining activities, which have accelerated land degradation, reduced slope stability, and diminished vegetation cover. These environmental changes threaten biodiversity and increase the risk of sediment accumulation that can obstruct the flow of the Cikaniki River.

The ecological consequences became evident through a series of disasters. On 1 January 2020, nine landslides occurred within the buffer zone of Gunung Halimun Salak National Park, severing transportation access and forcing 3,187 residents to evacuate, including 1,508 residents of Nyungcung Hamlet, who sought refuge in Cisangku Hamlet. Subsequently, on 24 April 2023, additional landslides struck several locations in Malasari Village, damaging homes and requiring further evacuations (Budhiyanto, 2025).

Against this backdrop, the Cisangku Conservation Village Model was established as a participatory conflict-resolution mechanism centered on community empowerment. Beyond serving as a platform for communication and coordination among stakeholders, the model functions as a bridge between conservation objectives and community economic needs through the development of various conservation-based productive livelihood programs.

Livelihood transformation

The Cisangku Conservation Village Model (CVM) has facilitated a significant transformation in the livelihoods of former Illegal Gold Mining (IGM) actors by creating legal, productive, and conservation-based economic opportunities. Rather than representing a simple occupational shift, this transformation reflects broader changes in community values, environmental awareness, and economic resilience. The program has encouraged

former miners to participate in productive activities that simultaneously improve household incomes and contribute to ecosystem restoration.

1. Traditional ground coffee production

Traditional ground coffee production has become one of the flagship community enterprises developed under the Cisangku Conservation Village Model. Beyond generating additional household income, this initiative preserves local cultural heritage by maintaining traditional coffee-processing techniques.

A distinctive feature of the product is the continued use of traditional wooden equipment known as keblek and lisung. Historically, these tools were used by local communities to pound rice. Through the Conservation Village Model, they have been repurposed to process roasted coffee beans into traditional ground coffee. This adaptation not only preserves local cultural identity but also transforms indigenous knowledge into an economic asset with commercial value (Atchison et al., 2025). The manual pounding process is believed to produce a distinctive aroma and flavor profile that differs from mechanically processed coffee, creating a unique selling point for consumers seeking authentic traditional products.

The coffee enterprise has generated tangible socioeconomic benefits, particularly for vulnerable groups within the community. Production activities employ nine elderly women and five single mothers (widows) as the primary workforce, providing them with opportunities to earn additional income without leaving their local community (Lather et al., 2026). During the initial stage of development, production capacity was limited to approximately 50 jars per month. As market demand increased, production expanded to 165 jars per month. With a selling price of approximately IDR 45,000 per jar, the enterprise now generates a monthly revenue of approximately IDR 7,425,000. These findings demonstrate that leveraging local wisdom and cultural heritage can create competitive advantages while simultaneously improving community welfare (Platzek et al., 2026).

2. Conservation-based ecotourism

Conservation-based ecotourism has emerged as another important livelihood alternative within the Cisangku Conservation Village Model. The program engages 11 unemployed young adults of productive working age, providing them with meaningful economic opportunities and strengthening their social participation within the community (Fadhlia et al., 2025). These young community members are responsible for managing a range of tourism services, including visitor ticketing, campsite operations, and the maintenance of tourism facilities. Revenue generated from ecotourism has contributed substantially to the income of the management group. Ticket sales generate an average monthly income of approximately IDR 6,000,000, while campsite operations contribute an additional IDR 3,000,000 per month.

The success of the ecotourism initiative depends not only on the area's natural attractions but also on the sustainability of the social, cultural, economic, and institutional values embedded within the local community (Merven et al., 2025). Consequently, conservation-based ecotourism should be understood as part of a broader social-

ecological system, in which ecosystem conservation and community well-being are mutually reinforcing objectives.

3. Endemic plant nursery and environmental rehabilitation

The establishment of endemic plant nurseries has become a central component of environmental rehabilitation under the Conservation Village Model. Since 2019, community members have planted 356,000 trees representing 23 endemic plant species, making a substantial contribution to ecosystem restoration, watershed protection, and the long-term availability of clean water for surrounding communities. In addition to large-scale collaborative tree-planting initiatives involving the Conservation Village Model, government agencies, and PT ANTAM UBPE Pongkor, community members independently plant an average of 1,500 tree seedlings annually (PT ANTAM Pongkor Social Innovation Environmental Impact Assessment Report, 2025). Beyond environmental benefits, the nursery program also provides an additional source of income through the sale of seedlings to government institutions and corporate partners.

Table 1. Number of Seed Purchases

No	Institutions/Private Sectors	Number of seedlings
1	Citali Regional Forestry Agency	80.200
2	Bandung Forestry Agency	6.800
3	Geomin Arinem Garut	8.000
4	Gunung Talaga Resort	5.450
5	Gunung Kencana Resort	3.000
6	Salak Resort	2.421
7	Star Energi	11.126
8	Citali Regional Forestry Agency	13.113
9	Pabangbon Forestry Research Group	4.000
10	Nyungcung Forestry Research Group	4.000
11	PT. Prima Karya	2.825
12	Perhutani	135
13	Citali Regional Forestry Agency	46.500
14	Puspitek	3.030
15	BPDAS	18.400
16	Bandung Research Center	1.000

17	PT. Sediana Cirewed	4.900
18	IPB Bogor	300
19	Gunung Butak Resort	8.200

Source: Cisangku MKK Group Document, 2025

The involvement of 18 former Illegal Gold Mining actors in nursery development and conservation activities demonstrates a profound transformation in both material and non-material dimensions of well-being. From an economic perspective, members' average income increased by 42% through participation in conservation-based livelihood activities. At present, members of the Cisangku Conservation Village Model earn approximately IDR 3,000,000 per month from legal, stable, and sustainable sources of income.

These findings support the argument that social transformation cannot be achieved solely through economic growth or technological

innovation. Rather, it requires a fundamental shift in societal perspectives regarding well-being, social justice, and ecological responsibility to ensure that development remains within environmental limits (Blühdorn, 2022). The average monthly income of 25 members of the Conservation Village Model increased from IDR 1,688,000 before joining the program to IDR 2,404,000 after participating in conservation-based economic activities. This represents an average increase of IDR 716,000, or 42%. At the individual level, the largest income was experienced by Hendrik, whose monthly earnings rose from IDR 2,000,000 to IDR 3,500,000, representing an increase of 75%.

Table 2. Percentage Increase in Revenue

No	Group Member Name	Income Before (IDR)	Income After (IDR)	Income Increase (IDR)	Percentage Increase
1	Hendrik	2.000.000	3.500.000	1.500.000	75%
2	Saji	1.500.000	2.400.000	900.000	60%
3	Ama H. Usup	2.500.000	3.300.000	800.000	32%
4	Aceng	1.700.000	2.500.000	800.000	47%
5	Erwin	2.000.000	2.500.000	500.000	25%
6	Yadi	2.000.000	2.700.000	700.000	35%
7	Dadan	1.500.000	2.500.000	1.000.000	67%
8	Sopian	2.000.000	2.700.000	700.000	35%
9	Jaman	2.000.000	2.900.000	900.000	45%
10	Ujang	2.000.000	2.700.000	700.000	35%
11	Uci	1.500.000	2.500.000	1.000.000	67%
12	Kurdi	2.500.000	3.000.000	500.000	20%
13	Suhendar	2.500.000	3.000.000	500.000	20%
14	Mumuh	2.000.000	2.700.000	700.000	35%
15	Saito	1.500.000	2.500.000	1.000.000	67%
16	Amir	2.000.000	2.500.000	500.000	25%
17	Lukman	2.000.000	2.500.000	500.000	25%
18	Ajat Sudrajat	2.000.000	2.700.000	700.000	35%
19	Katik P	1.000.000	1.500.000	500.000	50%
20	Elis R	1.000.000	1.700.000	700.000	70%
21	Nining	1.000.000	1.500.000	500.000	50%
22	Ros	1.000.000	1.500.000	500.000	50%
23	Yati	1.000.000	1.600.000	600.000	60%

24	Enah	1.000.000	1.700.000	700.000	70%
25	Neneng	1.000.000	1.500.000	500.000	50%
Average		1.688.000	2.404.000	716.000	42%

Source: Cisangku MKK Group Document, 2025

The Conservation Village Model has therefore demonstrated its capacity to transform local livelihoods, particularly those of former illegal miners and other vulnerable community members from high-risk and environmentally destructive activities to safer, more productive, and sustainable sources of income (Osumanu, 2020). These findings indicate that conservation-based community empowerment constitutes an effective strategy for promoting social-ecological transformation while strengthening sustainable livelihoods in conservation buffer zones.

4. The role of the local hero and multi-stakeholder collaboration in social-ecological transformation

The Cisangku Conservation Village Model (CVM) currently comprises a well-established organizational structure with clearly defined roles and responsibilities that enable community members to collectively implement conservation-based economic activities. Of its members, 69% are former illegal loggers and Illegal Gold Mining (IGM) actors, demonstrating the program's success in transforming individuals previously engaged in environmentally destructive activities into active participants in environmental conservation.

The success of this transformation is closely associated with the leadership of Hendrik, the chairperson of the Cisangku Conservation Village Model and a recognized local hero. Hendrik was formerly involved in Illegal Gold Mining in Cisangku. Through his participation in community empowerment initiatives and conservation programs, he underwent a profound personal transformation and has since become the central figure driving the development and success of the Conservation Village Model.

The presence of a local hero plays a critical role in facilitating social change (Boström & Callmer, 2025). Hendrik's personal transformation

has inspired other community members in both Cisangku Hamlet and Malasari Village to abandon illegal mining activities and engage in conservation-based livelihoods. His leadership has strengthened community participation in environmental protection while fostering greater local economic self-reliance through sustainable livelihood initiatives.

In recognition of these contributions, Hendrik and the Conservation Village Model received an award from the Ministry of Environment and Forestry of the Republic of Indonesia in 2020 for their achievements in developing community-based tree nurseries and environmental rehabilitation programs. This recognition reflects the important role of local leadership in promoting conservation and sustainable rural development.

Community participation also serves as a mechanism for maintaining social control and ensuring the sustainability of development by creating a balanced relationship among government, the private sector, and local communities (Harris, 2021). Sustainability emphasizes the capacity of social, economic, and environmental systems to endure and continue generating long-term benefits. Within this context, stakeholder participation is fundamental because community empowerment is inherently a collective process aimed at strengthening local capacities (Hopner, 2023). This collaborative approach is closely aligned with the concept of partnership, which constitutes one of the key principles of the Sustainable Development Goals (SDGs), particularly Goal 17: Partnerships for the Goals. Achieving sustainable development requires effective collaboration among governments, the private sector, civil society organizations, and local communities, with each stakeholder contributing complementary resources and expertise.

The government plays a pivotal role by establishing supportive regulations, providing policy direction, and facilitating community development (Jiatong et al., 2021). The private sector contributes through financial support, technical assistance, and the implementation of Corporate Social Responsibility (CSR) programs (CSR) (Cummings et al., 2022). Local communities serve as the principal actors responsible for implementing conservation initiatives and ensuring their long-term sustainability (Wang et al., 2025). Within this collaborative governance framework, the local hero functions as a change agent who fosters trust, mobilizes community participation, and facilitates behavioral change. More importantly, local heroes occupy a strategic position in advancing sustainability because they are not merely beneficiaries of development programs but also role models who inspire broader community engagement. Their lived experiences, social legitimacy, and close relationships with local residents enable them to bridge the gap between communities and external stakeholders, thereby strengthening the long-term sustainability of community-based development initiatives.

CONCLUSION

The Cisangku Conservation Village Model (CVM) is a sustainability-oriented community empowerment initiative that contributes to the achievement of the 17 Sustainable Development Goals (SDGs) through integrated environmental, economic, and social interventions.

From an environmental perspective, the program has facilitated the planting of 356,000 trees, contributing to an estimated reduction of 5,352 tons of CO₂ equivalent (CO₂e) emissions per year. This achievement demonstrates the program's contribution to ecosystem restoration while strengthening climate change mitigation efforts.

From an economic perspective, the Conservation Village Model has created diverse and sustainable livelihood opportunities through endemic plant nurseries, traditional ground coffee production, and conservation-based ecotourism. As a result, the annual income of the Cisangku Conservation Village Model increased from IDR

238,570,000 to IDR 613,072,000, representing an increase of 156%.

From a social perspective, individuals who were formerly engaged in Illegal Gold Mining (IGM) have transformed from exploiters of natural resources into active stewards of forest conservation through the participation of 26 members in various conservation initiatives. In addition, the program has strengthened youth participation in community development and expanded opportunities for vulnerable groups to engage in productive economic activities.

Overall, the findings demonstrate that conservation-based community empowerment is an effective strategy for promoting social-ecological transformation by integrating livelihood diversification, ecosystem restoration, and collaborative governance. The success of the Cisangku Conservation Village Model is supported by strong partnerships among government institutions, the private sector, local communities, and the leadership of a local hero, whose role has been instrumental in fostering trust, encouraging community participation, and facilitating behavioral change.

The Cisangku Conservation Village Model offers a practical and replicable framework for addressing the social and environmental challenges associated with Illegal Gold Mining in conservation buffer zones. By strengthening sustainable livelihoods while restoring ecological functions, the model provides valuable insights for policymakers, practitioners, and community organizations seeking to design integrated community empowerment programs that support long-term sustainable development.

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