Development of the Serayu Network Social Innovation as An Effort to Preserve the Sustainability of the Serayu Watershed Ecosystem

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Abstract

Banjarnegara Regency, as an agrarian region, is highly dependent on the sustainability of the Serayu Watershed ecosystem. However, land use changes in the upstream area have triggered environmental degradation in the form of erosion, sedimentation of the Mrica Reservoir, and a decline in water quality, all of which impact the community's economic vulnerability. In response to these issues, PT PLN Indonesia Power UBP Mrica initiated the Serayu Network Program as a social innovation that integrates environmental conservation with the strengthening of the local economy. Through six stages of social innovation, the program was systematically developed with a sustainability orientation, implemented through integrated farming in the Kampung Ilmu Serayu Network as well as the empowerment of vulnerable groups through vocational training. The program's outcomes demonstrate multidimensional impacts, including the restoration of the watershed's ecological functions, increased community income, business diversification, and innovations based on the circular economy. Therefore, the Serayu Network serves not only as a model of local empowerment but also as a representation of social innovation with the potential to be replicated in other watersheds in Indonesia as an effort to build sustainable socio-economic and ecological resilience.

Keywords: *Serayu Watershed, Social Innovation, Community Empowerment.*

A. INTRODUCTION

Banjarnegara Regency is one of the administrative entities in Central Java Province, astronomically located at coordinates 7°12′–7°31′ South Latitude and 109°20′–109°45′ East Longitude. Its spatial configuration directly borders Pekalongan and Batang Regencies in the north, Wonosobo Regency in the east, Kebumen Regency in the south, and Purbalingga and Banyumas Regencies in the west. The region, covering an area of 106,971.70 hectares, displays a strong rural character, with 95.68% of its administrative units comprising 266 villages and only 12 subdistricts (Statistics Indonesia of Banjarnegara Regency, 2023a). These geographical characteristics have direct implications for the dominance of the agrarian sector in land use. Data indicate that 58.14% of the total land area, equivalent to 62,203.58 hectares, is allocated for agricultural activities (Statistics Indonesia of Banjarnegara Regency, 2023a). Dependence on this sector is also reflected in the demographic constellation. Of the total population of 1,038,718 in 2022, as many as 188,641 people (18.16%) worked in

the agricultural sector. The majority of them, namely 131,584 farmers (69.75% of all farmers), depended on seasonal crops, while 87,175 farmers (46.21%) were also engaged in the livestock subsector (Statistics Indonesia of Banjarnegara Regency, 2023b).

Economically, the agricultural sector constitutes the backbone of Banjarnegara Regency's Gross Regional Domestic Product (GRDP) (Jariyah & Pramono, 2013). In 2022, the sector contributed 29.61% of GRDP, amounting to IDR 7.40 trillion. Although its percentage slightly declined compared to 2017 (32.14%), the nominal value continued to increase, even reaching IDR 7.78 trillion in 2023. The estimated average annual income of farmers in 2022, amounting to IDR 39,236,539.24, or 44.34% higher than the regional minimum wage at that time, indicates that this sector is not only strategic for the regional economy but also vital for the community's standard of living. This series of data reaffirms the position of Banjarnegara Regency as a rural area whose economy is supported by agrarian activities.

The dominance of agrarian activities makes inland aquatic (fluvial) ecosystems the primary support system for life in Banjarnegara Regency. Hydrologically, the regency lies within the Serayu–Bogowonto River Basin Territory, an area designated as a National Strategic River Basin (Ministry of Public Works and Public Housing, 2015a; 2015b). More than 85% of land in this territory is utilized for agrarian activities (Directorate General of Water Resources, 2017). More specifically, Banjarnegara Regency is an integral part of the Serayu Watershed, which covers 372,536 hectares, with 84.48% of its land use dedicated to agriculture.

However, the Serayu Watershed faces serious environmental pressures. Most of its land is categorized as potentially critical to critical, with erosion hazards classified as "Moderate," potentially producing 241,559 tons of erosion annually (Analysis Result, 2015 in the Serayu–Bogowonto River Basin Water Resources Management Plan, 2016). This high level of erosion is exacerbated by agricultural practices that poorly apply conservation principles (Jariyah & Pramono, 2013). As a result, the Serayu Watershed has been designated as one of the 108 national priority watersheds requiring rehabilitation (Ministry of Environment and Forestry, 2019; Salma et al., 2024). The focal point of environmental issues in this context lies in the upstream watershed areas, which should ideally serve as protective zones (Asdak, 2010). The upstream area of the Serayu Watershed, 45.64% of which lies within Banjarnegara Regency, has experienced drastic land use changes. Between 2009 and 2019, forest cover decreased by 13,907.30 hectares, while agricultural land expanded by 11,261.66 hectares, making agriculture the dominant land use (Susanti et al., 2020). This transformation has become the primary trigger of degradation.

The consequences of upstream changes are highly significant. Water quality has become a strategic issue, as indicated by the declining trend in the Water Quality Index from 52.65 points (2019) to 42.01 points (2022) (Banjarnegara Regency Government, 2024). Intensive land use on upstream slopes for horticulture is suspected to trigger massive erosion, leading to accelerated sedimentation in the Mrica Reservoir (Rustanto, 2019). This phenomenon, reinforced by various studies

(Wu et al., 2018; Badu, 2023; Wani et al., 2024), not only threatens the sustainability of vital infrastructure but also has direct impacts on the community.

This ecological vulnerability directly translates into economic and food vulnerabilities. The dependence of tens of thousands of farmers in Bawang District (8,340 people) and Purwanegara District (16,230 people) on degraded water resources has produced tangible consequences. Data show a sharp decline in agricultural productivity between 2019 and 2021. In Bawang District, the total productivity of horticulture and fruits plummeted by 87.05%, while in Purwanegara the decline reached 87.61%. These figures illustrate how environmental degradation in the upstream watershed has direct implications for food stability and the local economy.

Considering the geographical position of PLTA PB Soedirman located in the downstream watershed area, PT PLN Indonesia Power UBP Mrica initiated environmental preservation catalysts at several points within Banjarnegara Regency that are experiencing environmental degradation, including upstream areas. Bawang Village and Gumiwang Village, located in the downstream area of the Serayu Watershed in Banjarnegara Regency, microscopically represent the general problems faced by the region, namely land degradation intertwined with low community economic resilience. In Bawang Village, vulnerability is dominated by seasonal crop farmers cultivating steep lands. Their dependence on climate and market prices makes them prone to crop failure, particularly among poor households working as farm laborers. In Gumiwang Village, vulnerability is concentrated among persons with disabilities who have limited access to employment. Most rely on the agrarian sector as landless laborers. This context indicates a significant contradiction: on the one hand, there is a low level of community economic resilience, but on the other, there remains untapped local potential. This includes the use of water hyacinth as animal feed, reservoir sediment as planting media, and the diversification of agricultural products such as goat's milk, organic fertilizer, and silage feed. Such potential provides opportunities to build a more adaptive and environmentally friendly economic model.

To address the existing complex problems, the Perusahaan Listrik Negara Indonesia Power Unit Bisnis Pembangkit Mrica initiated the "Serayu Network", a framework of empowerment that integrates watershed (DAS) conservation with the strengthening of the local economy. This program focuses on an integrated farming system based on four pillars, implemented through two synergistic sub-programs. First, Kampung Ilmu Serayu Network functions as a training center for farmers to master conservation techniques, transform waste into value-added products, and diversify income sources. Second, Vokasi Disabilitas SWP Dadi Mulya specifically empowers vulnerable groups such as persons with disabilities through vocational training based on local potential to foster economic independence and social inclusion. Through this holistic approach, the "Serayu Network" is expected not only to address environmental degradation but also to build community social and economic resilience, transforming the perspective that environmental preservation is a strategic investment for a more prosperous and sustainable future.

B. RESULTS AND DISCUSSION

Social problems arising in society are often expected to be resolved through the presence of social innovation. Firdaus and Prasetiyo (2024) explain that social innovation plays a role in creating social transformation capable of providing solutions to various social problems. In line with this, Moridu et al. (2023) define social innovation as new approaches, strategies, and solutions designed to address social challenges while simultaneously fostering positive social change. Furthermore, Moridu et al. (2023) emphasize that social innovation is generally born from cross-sectoral collaboration among stakeholders. The presence of social innovation enables the creation of more effective solutions than previous approaches, so that the resulting social transformation can support sustainability and improve the quality of life of communities.

The process of social innovation can be explained through the conceptual framework developed by Caulier-Grice, Mulgan, and Murray (2012). This framework highlights the stages undertaken in the development of social innovation, which consist of six main phases: (1) prompts (identification of social needs), (2) proposals (formulation of social innovation program development strategies), (3) prototypes (pilot projects or initial trials), (4) sustaining (strengthening and maintaining ongoing programs), (5) scaling (expansion and amplification of program impact), and (6) systemic change (creation of systemic transformation within society).

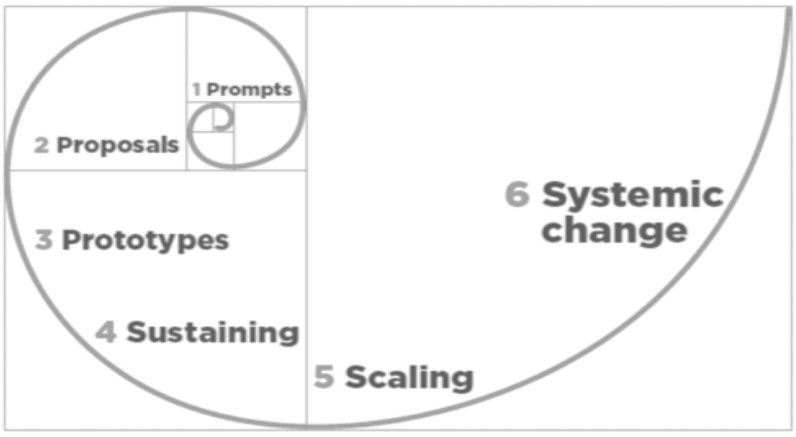

Figure 1. Process and Stages of Social Innovation
Source: Caulier-Grice et al., 2012

The depiction of social innovation stages is used to examine how PT PLN Indonesia Power UBP Mrica PLTA PB Soedirman implements social and environmental responsibility practices through the Serayu Network Program. This program is designed as a form of social innovation that integrates environmental sustainability with the improvement of community welfare in the Serayu Watershed area. Its implementation dynamics are analyzed through six stages of social innovation, including prompts, proposals, prototypes, sustaining, scaling, and systemic change, to illustrate the resulting social transformation. Furthermore, the main characteristics of social innovation in this program include novelty, systematic and measurable planning, responsiveness to social needs, implementation

effectiveness, and contributions to enhancing community capacity. Therefore, the Serayu Network Program can be holistically understood as an innovative strategy that provides tangible solutions to socio-ecological challenges while strengthening the sustainable development agenda in the Serayu Watershed.

The prompts stage is the initial phase in the social innovation process, namely, building collective awareness of the crucial problems faced by the community. At this stage, community needs are identified to encourage the creation of social transformation that can deliver tangible solutions. In the context of the Serayu Network Program, this initial stage was carried out by referring to the Social Mapping Document of PT PLN Indonesia Power UBP Mrica PLTA PB Soedirman (2022). The mapping served to recognize more deeply the potentials and problems that exist, while simultaneously forming the basis for formulating program initiation strategies. Social mapping activities are routinely carried out by PT PLN Indonesia Power UBP Mrica PLTA PB Soedirman, thereby providing a comprehensive and measurable initial database to support the planning of social innovation programs.

Based on the results of social mapping, the Serayu Watershed is included among the 15 critical watersheds prioritized for restoration due to upstream damage (PLTA PB Soedirman Mrica PGU, 2022). This damage was triggered by land-use conversion, namely the degradation of forests into horticultural agricultural land. Such changes in land use have direct implications for the decline in the carrying capacity of the Serayu Watershed, marked by an increase in erosion, namely the detachment and transportation of soil layers from one location that later accumulate in another area (Salma et al., 2024). The erosion rate, reaching around 161 tons/ha/year (PLTA PB Soedirman Mrica PGU, 2022), indicates that the ecological function of the Serayu Watershed as a conservation area is not working optimally, particularly in regulating water systems, controlling erosion, and reducing sedimentation. This condition raises concerns over the widening of negative impacts, not only for upstream areas but also for midstream and downstream areas that depend heavily on the sustainability of the Serayu Watershed's functions (Salma et al., 2024).

One of the operational risk mitigation efforts undertaken by the company is flushing, namely the process of discharging sediments from the reservoir to reduce disruptions to power plant operations (Marhendi & Suryana, 2020). PT PLN Indonesia Power UBP Mrica PLTA PB Soedirman routinely carries out this activity. However, such practice causes significant socio-ecological impacts, such as the death of thousands of fish and the disruption of PDAM Banyumas operations due to deteriorating water quality (PLTA PB Soedirman Mrica PGU, 2022). This condition is related to reservoir sedimentation that has reached 87%, exceeding its normal capacity, thereby not only reducing water regulation functions but also revealing a dilemma between the operational interests of the company and the sustainability of ecosystems and community livelihoods in downstream areas.

Given the degraded condition of the Serayu Watershed, collective efforts involving multiple parties are required in a conservation movement that integrates ecological and economic aspects in a balanced manner. The main focus is directed at

the restoration of the upstream area of the Serayu Watershed as a conservation zone to prevent erosion and suppress sedimentation rates through the planting of various types of productive trees. On the other hand, attention to the welfare of horticultural farmers is an equally important aspect that cannot be overlooked. Many farmers face vulnerability due to crop failure and limitations in applying standardized farming systems.

In this context, PT PLN Indonesia Power UBP Mrica PLTA PB Soedirman has taken the initiative to integrate area conservation approaches with the application of integrated farming systems. The aim is to support the improvement of farmers' welfare while simultaneously maintaining environmental sustainability around the Serayu Watershed. Therefore, the prompts stage in the social innovation of the Serayu Network Program can be concluded as an essential phase that underscores the urgency of the problems. This stage successfully identified the main needs that must be addressed through social innovation programs, namely the ecological restoration of the upstream watershed and the improvement of community welfare through sustainable farming practices. This initial identification has become a strategic foundation for formulating social innovation in the subsequent stage.

The proposals stage is a phase marking the transition from problem identification to the formulation of solutions that are more systematic, participatory, and based on local capacities (Caulier-Grice et al., 2012). At this stage, the ideas of social innovation in the Serayu Network Program begin to be concretely formulated through the integration of ecological concepts with community economics, particularly through the development of integrated and sustainable farming systems. The proposal formulation process emphasizes not only the technical aspects of environmental conservation but also the creation of economic value capable of strengthening the socio-economic resilience of local farmers.

Furthermore, program formulation is carried out through a collaborative approach involving cross-sectoral participation of the company, local government, academic institutions, and local communities. One of the mechanisms used is the Focus Group Discussion (FGD), which functions as a deliberative space to unify perspectives, map needs, and agree on joint strategies. Thus, the proposals stage is not merely about designing interventions but also a process of building collective commitment and social legitimacy essential for the sustainability of the Serayu Network social innovation.

In general, the Serayu Network social innovation is part of the implementation of social and environmental responsibility of PT PLN Indonesia Power UBP Mrica PLTA PB Soedirman, designed to address the main issue of land-use conversion in the upstream Serayu Watershed. Such conversion has triggered increased erosion and sedimentation, which directly reduces the capacity of the Mrica Reservoir. At the proposals stage, program strategy formulation was directed at efforts to transform the community's farming system from conventional practices based on seasonal vegetables into integrated, environmentally friendly, and sustainable farming systems. This strategy is not only aimed at ecological conservation but also oriented

toward improving farmers' welfare through the integration of production, conservation, and local economic functions.

The program's core activities are realized through the establishment of Kampung Ilmu Serayu Network, centered in Bawang Village, Bawang District, Banjarnegara Regency, Central Java. This village functions as an innovation hub as well as a platform for developing an integrated farming system, characterized by the development of dairy goat farming as the main pillar. The presence of such farming encourages the cultivation of Hijau Pakan Ternak (HPT) such as Indigofera and Caliandra, which not only support feed availability but also act as perennial plants that strengthen conservation functions by reducing soil erosion. Furthermore, these activities also utilize environmental waste, such as sediment and water hyacinth, as planting media and organic fertilizer, thereby creating a sustainable farming cycle based on the principles of a circular economy.

Through this proposal formulation, the Kampung Ilmu Serayu Network is expected to serve as a center for education and training in the application of integrated farming systems involving farmer groups in an integrated manner. Therefore, the program is not only oriented toward environmental conservation but also opens up new economic opportunities, both for existing businesses and those still in the start-up stage. The proposals stage in the Serayu Network Program, therefore, emphasizes the importance of cross-sectoral collaboration in formulating intervention strategies that can deliver innovative solutions, while simultaneously strengthening social legitimacy and collective community commitment toward improving welfare around the Serayu Watershed.

After the proposal formulation stage was completed, the Serayu Network Program proceeded to the prototype phase. This stage represents the initial step of implementation as well as a testing ground for the designed solutions developed in the previous phase. Through this stage, the program not only tests the technical feasibility and effectiveness of the formulated strategies but also assesses the extent of community acceptance of the innovations offered. Thus, the prototype phase functions as a crucial early validation process before the program is expanded on a larger scale.

The prototype phase of the Serayu Network Program began implementation in 2023, focusing on institutional strengthening through the establishment of the Serayu Network Foundation. This foundation consists of 13 members with a management structure that includes Maman Fansyah as Chair of the Board of Trustees, Riza A. Azra as General Chair, and Anton Subagyo as Chair I, Hendrawan N.M as Secretary, and Mutiara L.A as Treasurer. Other members are divided into several responsible positions such as Head of Livestock, Head of Feed, and Head of Fertilizer. The presence of the Serayu Network Foundation has a strategic role as the main driving force in the implementation of Kampung Ilmu Serayu Network, located in Bawang Village, Bawang District, Banjarnegara Regency, Central Java.

The establishment of this foundation is considered crucial because strong and organized institutionalization serves as the foundation for structured and sustainable

activities. Through the Serayu Network Foundation, the activities of the Serayu Network Knowledge Village are strengthened by four main pillars in the integrated farming system, namely the Bank Peternakan (Livestock Bank), Bank Pembibitan (the Seed Bank), Bank Pakan (the Feed Bank), and Bank Pupuk (the Fertilizer Bank). These four pillars are integrated in such a way that they create synergy between production, conservation, and community empowerment activities, while also serving as an early manifestation of the concrete implementation of the social innovation ideas formulated at the proposal stage.

At the prototype stage, the Serayu Network Foundation initiated activities by utilizing land owned by PT PLN Indonesia Power UBP Mrica, which was optimized to have higher utility value while also providing benefits to the surrounding community. The initial activity was realized through the establishment of the Livestock Bank with a focus on dairy goat farming. The development of livestock facilities and the procurement of goats were fully supported by PT PLN Indonesia Power UBP Mrica PLTA PB Soedirman as a form of the company's commitment to strengthening program implementation. In its execution, the Serayu Network Foundation established a partnership with the Bima Lukar goat farmers' community, which consists of 113 farmers from eight sub-districts along DAS Serayu. Kolaborasi. This collaboration not only expanded the cooperation network but also strengthened the social legitimacy of the foundation in carrying out Livestock Bank activities as a pilot model of livestock-based integrated farming systems.

Subsequently, the prototype stage was further developed through Feed Bank activities, which play an important role in supporting the sustainability of dairy goat farming. Initial efforts were made by providing agricultural facilities and infrastructure to encourage self-sufficiency in feed production. The program was then reinforced by the Seed Bank initiative, namely the procurement of 29,600 forage crop seedlings that function not only as a source of livestock feed but also as a land conservation instrument in the upstream area of the Serayu Watershed. At this stage, new innovations also emerged through the utilization of sediment waste, which had previously been considered a major problem in the Serayu Watershed. The sediment was used as a planting medium in the seedling, planting, and vegetable farming process, and was also processed into building materials in the form of bricks to support infrastructure needs in the Serayu Network Knowledge Village. In addition, livestock manure was managed into organic fertilizer, developed into an innovative product called Pupuk Organik LIDOK, which was subsequently managed under the Fertilizer Bank activities. Therefore, the prototype stage of the Serayu Network Program not only served to test the technical feasibility of the ideas formulated at the proposal stage but also produced practical innovations that demonstrated the integration of ecological, social, and economic aspects in a sustainable manner.

Entering the sustaining stage, the Serayu Network Program is projected as a social innovation oriented toward sustainability. This aligns with the program's initial vision, namely realizing continuity through the integration of the four main pillars of the integrated farming system. In 2024, the implementation of activities within each

pillar began to demonstrate their strategic functions in building a strong and resilient farming system. This stage began with socialization activities emphasizing the importance of the community's role in improving the condition of the Serayu Watershed, particularly in the upstream area as a conservation zone, through the planting of productive crops and hardwood trees.

After the socialization, implementation continued throughout the year through cross-sector collaboration in planting activities in the Serayu Watershed conservation area. The Serayu Network Foundation successfully mobilized the Bima Lukar farmers' community and involved various multi-sector stakeholders to participate in conservation activities. By December 2024, a total of 12,625 forage crop seedlings, 2,000 sugar palm trees, and 1,800 fruit plants had been planted. These planting efforts are expected to enhance the carrying capacity of the Serayu Watershed, particularly in restoring its ecological functions as a water regulator, erosion controller, and sedimentation reducer.

Furthermore, the sustainability efforts in the Serayu Network Program are reflected in the strengthening of the livestock sector, particularly dairy goat farming. This step is demonstrated through the improvement of supporting facilities, such as the renovation of pens and the construction of a special lane connecting the pens with the milking area, thereby increasing efficiency and hygiene in the production process. These efforts not only reinforced the technical aspects of livestock farming but also laid the foundation for improving the quality and quantity of livestock production.

In addition, the sustainability program was expanded through diversification in the livestock sector with the development of aquaculture. This diversification was realized through the construction and addition of fish ponds, which also supported efforts to optimize self-produced feed. Innovations in the Feed Bank not only focused on meeting livestock feed needs but also resulted in the production of fish feed pellets, further strengthened by the procurement of a pellet-making machine and a drying oven. This diversification of activities illustrates the ability of the Serayu Network Program to create synergy between the livestock and aquaculture sectors, thereby expanding economic benefits while maintaining ecological balance.

These various developments demonstrate the commitment of the Serayu Network Foundation in establishing the Serayu Network Knowledge Village as a center for education, innovation, and the implementation of sustainable integrated farming systems. Therefore, the sustaining stage not only serves to maintain the continuity of the program but also strengthens cross-sector integration that can deliver long-term impacts for the community, environment, and local economy.

The social innovation of the Serayu Network Program, through its main activity, the Serayu Network Knowledge Village, has shown consistent implementation across the four main pillars that form the foundation of the program. This consistency demonstrates that the Serayu Network Foundation, with continuous support from PT PLN Indonesia Power UBP Mrica PLTA PB Soedirman, has consistently sought to develop the program systematically and purposefully. Entering the scaling stage, the Serayu Network Program is not only focused on internal

sustainability but also directed toward scaling up activities so that the scope of its benefits can be expanded to a wider community.

Efforts to escalate the Serayu Network Program in 2025 were realized through the replication and development of livestock enterprises by expanding partnerships with the Kelompok Vokasi Disabilitas SWP Dadi Mulya in Gumiwang Village, Purwanegara District, Banjarnegara. This group, which initially focused on producing ciprat batik, received training in poultry farming (muscovy duck) as well as capital support, enabling them to diversify income sources while creating opportunities for persons with disabilities to participate in environmentally friendly agricultural practices. Innovation was also advanced through the utilization of water hyacinth as animal feed, which not only alleviates environmental problems around the Serayu Watershed but also strengthens aspects of sustainability and social inclusion. Therefore, the scaling stage of the Serayu Network Program demonstrates tangible transformation by more broadly and equitably integrating economic, ecological, and social dimensions.

Recognizing that the development and replication of livestock activities have the potential to generate broader positive impacts, the Serayu Network Program encouraged the emergence of an innovative product in the form of Pupuk Organik LIDOK. To ensure quality and enhance product credibility, laboratory tests were conducted at the Balai Besar Standardisasi dan Pelayanan Jasa Pencegahan Pencemaran Industri (BBSPJPPI) in Semarang City. This testing aimed to confirm the nutrient composition contained in the fertilizer so as to strengthen scientific legitimacy and open up opportunities for market expansion within society. The program's commitment to developing this sector was further demonstrated through the construction of a fertilizer storage warehouse and the provision of more adequate production facilities and infrastructure. The synergy between livestock activities and the utilization of animal waste for Pupuk Organik LIDOK not only strengthens the local economic value chain but also contributes significantly to conservation efforts in the upstream areas of the Serayu Watershed, particularly through the provision of organic fertilizer to support seedling and planting activities.

Entering the scaling stage, the success of the Serayu Network Program as an escalation effort cannot be separated from the active involvement of cross-sector actors, particularly in conservation and forest reforestation activities in the upstream areas of the Serayu Watershed. A concrete example of this collaboration is the involvement of the Bukit Peterangan Community, consisting of 25 members and focusing on tree-planting activities in the upstream region. This community plays a strategic role in forest rehabilitation by planting various types of hardwood trees, such as puspa and acacia, which function to strengthen vegetation cover, reduce landslide risk, and curb erosion rates. Throughout 2025, the efforts of this community succeeded in planting approximately 20,000 tree seedlings. This collaboration further strengthened the Serayu Network, which had previously been established through the involvement of the Bima Lukar goat farmer community in the planting of forage crops (HPT). The integration of cross-communities, disability vocational groups, local

governments, and other stakeholders demonstrates that the Serayu Network Program not only succeeded in replicating conservation activities but also consolidated social innovation by combining local potential, multi-stakeholder support, and corporate commitment. Thus, this escalation effort affirms the role of the Serayu Network as a conservation-based empowerment model that strengthens the ecological carrying capacity of the Serayu Watershed while simultaneously enhancing the socio-economic sustainability of surrounding communities.

The systemic change stage in the Serayu Network Program emphasizes that the integration of social innovation can generate mutually reinforcing multidimensional benefits. Ecologically, the rehabilitation of critical land through the planting of conservation vegetation and forage crops or hijauan pakan ternak (HPT) provides significant contributions to restoring the ecological functions of the Serayu Watershed. This intervention not only curbs erosion and reduces sedimentation in the Mrica Reservoir but also revives the productivity of previously degraded land. Socio-economically, communities directly benefit from increased income, sustainable livestock feed sources, and active engagement in community-based conservation practices. Consequently, conservation is no longer viewed solely as an ecological obligation but as an economic strategy that strengthens community livelihood resilience while preserving the reservoir's function as a source of clean energy.

The success of systemic change is further reinforced through the integrated farming model of four pillars, including dairy goat farming, feed banks, fertilizer banks, and seed banks, which serves as the foundational framework for sustainable innovation. This model functions not only as a local solution but is also designed for replication in other sub-watershed areas. The presence of the Kampung Ilmu as a learning hub provides a practical arena that integrates knowledge transfer, community capacity building, and synergy with various stakeholders. Through this approach, the Serayu Network builds a collaborative ecosystem that emphasizes not only program outputs but also the cultivation of new mindsets oriented toward sustainability.

The novelty of the program lies in its ability to link household farming interests with long-term ecological objectives. The strategy of "goat farming drives conservation" positions household economic needs as the entry point for behavioral change. By raising dairy goats, farmers are naturally encouraged to cultivate forage crops such as indigofera and calliandra, which serve a dual function as quality feed and conservation plants that prevent erosion. Waste-based innovation also strengthens the sustainability of this model, including processing livestock manure into Pupuk Organik LIDOK, utilizing sediment from the Mrica Reservoir as a growing medium for organic vegetables, and converting water hyacinth into raw materials for feed and liquid fertilizer. These innovative products not only expand household economic diversification but also reinforce the concept of a circular economy contextualized to local conditions.

Through a combination of conservation strategies, product innovation, and community empowerment, the Serayu Network Program brings forth systemic

change with impacts across multiple layers. Economically, communities gain additional income from livestock, organic fertilizer products, and diversified dairy processing. Socially, inclusive communities are established, including the involvement of vulnerable groups such as persons with disabilities in productive activities. Ecologically, there are improvements in land quality, reduced sedimentation, and strengthened forest vegetation in the upstream watershed areas. Through this multidimensional integration, the Serayu Network Program demonstrates that social innovation can move beyond the project scale, becoming a model of sustainable systemic change with strong potential for replication in other watersheds in Indonesia.

C. CONCLUSION

Banjarnegara Regency is a rural area with an economic structure highly dependent on the agrarian sector, particularly seasonal agriculture. This dependency makes inland water ecosystems, especially the Serayu Watershed, the main support for the continuity of the local community's economy and social life. However, massive land-use changes in the upstream watershed have caused severe environmental degradation in the form of erosion, sedimentation in the Mrica Reservoir, and declining water quality. This ecological damage directly impacts economic vulnerability, as reflected in agricultural productivity declines of more than eighty percent in several districts. This situation creates a paradox, in which communities face high economic vulnerability while in fact there exists untapped local potential to improve welfare. In response to this issue, PT PLN Indonesia Power UBP Mrica introduced the Serayu Network Program as a social innovation that integrates environmental conservation with the strengthening of the local economy. The program was developed through six stages of social innovation, ensuring it progresses systematically and with a sustainability orientation.

Its implementation is realized through the Serayu Network Knowledge Village with four pillars of integrated farming, along with the empowerment of vulnerable groups such as persons with disabilities through vocational training. As the program progresses, multidimensional impacts have become evident, including the restoration of watershed ecological functions, increased community income, business diversification, and the emergence of circular economy–based innovations. With these achievements, the Serayu Network has not only become a model of local community empowerment but also a concrete representation of social innovation capable of creating systemic change with strong potential for replication in other watersheds in Indonesia.

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