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From Leader-Driven Action to Collective Learning: An Adaptive Community Empowerment Model in Circular Waste Economy

Herlina Siregar[1], Ahmad Fauzi[2], Fitri Pertiwi[3], Ahmad Rizaldi[4]
[1,2,3,4]Sultan Ageng Tirtayasa University, Serang, Indonesia

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ABSTRACT

Objective: This study aims to analyze how community empowerment develops within a waste-based circular livelihood model in a low-capacity context, with particular attention to the role of adaptive leadership as a transitional mechanism toward participatory autonomy. **Method:** The research employed a qualitative Participatory Action Research (PAR) design conducted at Padepokan Siloka SMART, a tempe-producing community facing environmental challenges due to unmanaged soybean pulp waste. Data were collected through semi-structured interviews, participatory observation, focus group discussions, and documentation. The data were analyzed using thematic analysis involving open, axial, and selective coding to identify patterns in leadership dynamics, livelihood adaptation, and experiential learning processes. **Results:** The findings indicate that empowerment did not initially emerge from spontaneous participation but from leader-driven initiation due to limited reflective capacity and economic vulnerability among predominantly elderly members. Adaptive leadership functioned as a catalytic and pedagogical mechanism that scaffolded collective action. The integration of long-term livestock investment with short-cycle sorghum cultivation stabilized participation, reduced environmental pollution, diversified income sources, and strengthened social capital. **Novelty:** This study proposes an adaptive transitional empowerment model that reconceptualizes leadership as a staged learning mechanism rather than a contradiction to participation, contributing to recent educational research on experiential and context-sensitive community transformation.

INTRODUCTION

Community Empowerment Constitutes a strategic approach in social development aimed at enhancing the capacity of individuals and communities to manage resources independently and sustainably. In the context of home-based industrial communities, environmental and economic issues are often structurally interconnected. Unmanaged production waste not only generates ecological impacts but also reflects limited community capacity to transform local resources into economic added value. Therefore, waste management should not be viewed merely as a technical issue, but rather as a matter of capacity development, critical awareness, and the strengthening of socio-economic structures within the community.

Several studies indicate that small-scale industries tend to neglect waste management regulations, thereby exacerbating environmental pollution (Nursinta Dewi et al., 2022). Industrial waste, both solid and liquid, is frequently generated without adequate processing technology, increasing the risk of environmental degradation (Chen & Yan, 2022). These findings underscore how limited access to knowledge and technology intertwines with low environmental awareness in small-scale industrial practices.

The condition is particularly relevant to the research site, a *tempe* production center where most households depend on small-scale *tempe* enterprises for their livelihoods. The production process generates substantial quantities of soybean pulp waste, which had

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previously not been managed productively. The waste was disposed of indiscriminately, causing odor pollution and environmental disturbances. This situation reveals a gap between local resource potential and the community's capacity to manage it sustainably, while also indicating that the challenges faced are closely linked to collective capacity and prevailing economic mindsets.

Previous research further demonstrates that home-based industry actors are often not fully aware of the environmental consequences of the waste they produce (Haryono et al., 2024). Limited knowledge regarding waste management techniques contributes to pollution that ultimately affects the quality of life of surrounding communities. Moreover, infrastructural constraints and restricted access to improved processing technologies reinforce structural barriers in waste management (SUTALHIS & NOVARIA, 2024). Consequently, interventions that focus solely on technical solutions without strengthening social capacity risk being unsustainable.

In response to these issues, the literature on waste-based community empowerment generally emphasizes participatory approaches, technical skill enhancement, and the development of social entrepreneurship. Participatory approaches are widely regarded as prerequisites for program success, as they promote collective ownership and sustainability (Budiman & Liong, 2023). Numerous studies also highlight the importance of innovation grounded in local resources as a strategy for income generation and economic strengthening within communities.

However, most of these studies assume the existence of deliberative participatory readiness from the outset of program implementation. In practice, not all communities possess sufficient reflective and participatory capacity, particularly in contexts characterized by the dominance of older age groups or limited ability to formulate entrepreneurial ideas. Furthermore, the literature remains relatively limited in explaining how local leadership dynamics moderate participation during the initiation phase of empowerment, as well as how short-term and long-term economic strategies can be integrated as adaptive mechanisms to sustain engagement among low-income communities.

Although several studies confirm that involving communities from the program design stage enhances ownership and effectiveness (Kurdi et al., 2023; Budiman & Liong, 2023; Permatasari, 2021; Stanley et al., 2023; Aulia et al., 2024), few have systematically examined variations in participatory capacity shaped by grassroots leadership structures. For instance, limited attention has been given to contexts in which local figures or elderly groups hold dominant roles, or where critical reflection among community members remains underdeveloped. In other words, the relationship between local leadership and stages of participation in low-capacity contexts warrants further exploration.

Addressing this gap, the present study focuses on the dynamics of community empowerment at Padepokan Siloka SMART in transforming soybean pulp waste into social enterprise innovations through integrated livestock and agricultural practices. This initiative reconstructs waste as a productive asset while simultaneously developing an adaptive economic scheme that combines long-term livestock investment with short-cycle sorghum cultivation as an immediate income source.

This study offers a conceptual contribution in the form of an adaptive community empowerment model integrating waste management and livestock-based enterprises developed through local leadership. Unlike approaches that rely on full participatory engagement from the beginning, the findings indicate that in contexts of limited

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community capacity, empowerment processes tend to begin in a leader-driven manner as a transitional strategy for gradually building collective capacity.

Consistent with international scholarship, in low-capacity contexts, empowerment often begins with a strong leadership phase that catalyzes participation and models collective action before ownership is gradually expanded (Boronyak et al., 2022; Sukoco et al., 2024; Rizky Hidayatullah et al., 2021). Leadership plays a crucial role in formulating strategies, mobilizing resources, and generating early achievements that foster trust and experiential capacity within the community (Herawati et al., 2024; Gulati et al., 2020; Tomblin Murphy et al., 2022; Pinto et al., 2021; Buch et al., 2021). Transformational and empowering leadership styles have been shown to be effective in initiating collective action under resource constraints while balancing directive coordination with the gradual transfer of ownership (Sulistyorini et al., 2024; Tomblin Murphy et al., 2022).

This study conceptualizes community empowerment as a staged experiential learning process in which adaptive leadership functions as a transitional pedagogical mechanism. Rather than assuming immediate participatory readiness, the research demonstrates how leader-driven initiation can scaffold collective action, gradually cultivate reflective capacity, and integrate short-term and long-term livelihood strategies to sustain engagement. By examining the empowerment dynamics within a waste-based circular livelihood model, this study proposes a context-sensitive framework for understanding how leadership, economic adaptation, and social learning interact to generate sustainable community transformation.

The main issues in this research include the low participatory capacity of the community, reliance on short-term economic patterns, and the absence of sustainable waste management mechanisms. To address these issues, the research aims to analyze how community empowerment develops in the context of a waste-based circular economy by emphasizing the role of adaptive leadership as a transition mechanism toward more autonomous participation. This objective is methodologically aligned with the use of Participatory Action Research (PAR), as PAR allows researchers to directly capture the process of social change, leadership dynamics, and the formation of reflective capacity through the action-reflection cycle. This method is relevant in the context of low-capacity communities, where empowerment does not emerge spontaneously but is built gradually through mentoring, economic experimentation, and collective learning. Meanwhile, thematic analysis is used to identify conceptual patterns in community experiences, particularly related to the integration of short-term and long-term economic strategies, the transformation of perceptions about waste, and the transition from leader-driven initiatives to more mature participatory models. Thus, the integration between the problem, objectives, and methods strengthens the logical consistency and validity of the research findings.

RESEARCH METHOD

Research Design

This research uses a qualitative approach with a Participatory Action Research (PAR) design. This design was chosen because it is appropriate for examining the process of community empowerment, which occurs adaptively, contextually, and in stages. PAR allows research to be conducted through an iterative cycle consisting of: (1) planning, (2) action, (3) observation, and (4) reflection.

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Figure 1. PAR Cycle

This cyclical model is relevant to the research context, as behavioral change, capacity transformation, and the emergence of economic innovation within the community occur through an iterative and experience-based process. This design also facilitates active community participation at each stage, aligning with the research need to understand how adaptive leadership shapes the transition from a leader-oriented empowerment model to collective independence. Thus, PAR serves not only as a method but also as a framework that enables an in-depth understanding of the social, economic, and ecological dynamics within the community. This research uses a qualitative approach with a Participatory Action Research (PAR) design to examine the dynamics of community empowerment within a waste-based circular economy model. PAR was chosen based on its suitability for examining social processes that are adaptive, non-linear, and occur within the context of the community's daily lives. In the context of this research, PAR allows researchers to provide direct assistance, observe the process of changing community capacity, and understand how adaptive leadership functions as a transition mechanism towards more mature collective participation. Theoretically, PAR is relevant because empowerment is not understood as an end state, but as a collective learning process involving reflection, role negotiation, economic adaptation, and reconstruction of local knowledge. The conditions of low participatory capacity influenced by the dominance of elderly members, minimal entrepreneurial experience, and dependence on daily income make PAR an appropriate approach, because it provides space for the community to process at its own rhythm through the cycle of action and reflection. PAR also enables researchers to capture the dynamics of social organization that occur when local leadership acts as a facilitator, director, and prime mover in the early stages of empowerment.

Instruments and Procedures

The researcher acted as the primary instrument, managing field interactions, interpreting meaning, and maintaining reflexivity throughout the research process. Supporting instruments included: semi-structured interview guides, participant observation guides, photo documentation sheets, and community archives. Interviews were used to explore residents' perceptions, motivations, and experiences related to waste management, economic strategies, and leadership. Participatory observation enabled the researcher to record collective work practices, social interactions, and innovation adaptation processes

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such as sorghum-livestock integration. Documentation enriched triangulation with contextual evidence. The research procedure followed the PAR stages: (1) initial mapping and planning, (2) implementation of social action, (3) field observation, (4) collective reflection through group discussions. This cycle repeated throughout the empowerment process, providing a longitudinal picture of the development of community capacity.

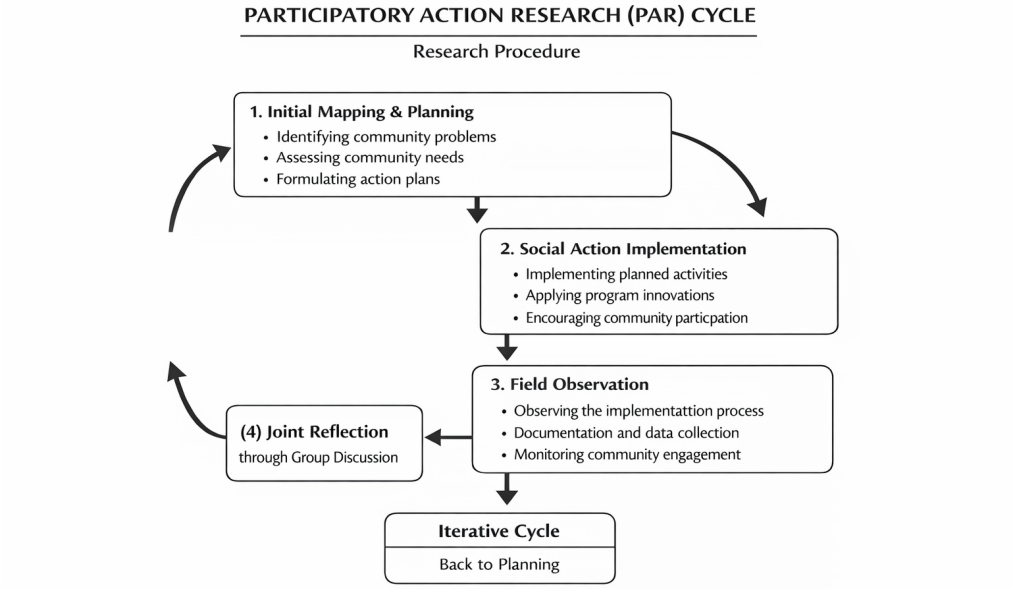

Figure 2. PAR Research Procedure Cycle

Data Analysis

The analysis was conducted using thematic analysis through three main stages: (1) Open coding, to identify units of meaning related to leadership, participation, economic strategies, and perceptions of waste; (2) Axial coding, to connect categories into analytical structures such as motivational stabilizers, leadership scaffolding, and experiential learning loops; and (3) Selective coding, to formulate core themes that reflect the dynamics of adaptive empowerment. This analysis provides flexibility to capture complex social processes and produce a context-sensitive empowerment model. The validity of the findings was strengthened through triangulation, member checking, and an audit trail. The coding process resulted in three core themes that explain the dynamics of community empowerment in the Siloka Smart community, as presented in Table 1.

Tabel 1. Thematic Coding Process

Open Coding	Axial Coding	Selective Coding
Participation depends on daily incentives	Economic motivation in participation	Instrumental
Limited community initiative in planning	Low participatory capacity	Community
Youth reluctant to engage in farming	Occupational perception barriers	Participation
Tempeh waste causes environmental problems	Waste management issue	Circular Waste
Waste processed into livestock feed	Waste-to-feed innovation	Innovation as
External stakeholders attracted by innovation	Innovation-driven collaboration	Transformation Driver
Leader demonstrates practices directly	Experiential leadership	Adaptive Leadership
Learning occurs through field practice	Practice-based learning	and Hybrid Livelihood
Integration of sorghum and livestock	Hybrid livelihood system	Strategy

Participants and Sampling

A total of five participants were involved in this study: one community leader, two active members of the livestock group, one member involved in sorghum cultivation, and one resident involved in waste collection and management. This relatively small number of

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participants aligns with the characteristics of Participatory Action Research (PAR)-based qualitative research, which emphasizes depth of experience, direct involvement in action, and the relevance of participants' roles to the empowerment process. This number is considered adequate to describe the social dynamics, adaptive leadership mechanisms, and collective learning processes that are the focus of the study. The characteristics of the participants are presented in Table 2.

Table 2. Participant Characteristics

Informant Code	Role in Community	Main Activity	Length of Involvement
Informant A	Community Leader	Program coordination and mentoring	5 years
Informant B	Livestock Group Member	Livestock management	2 years
Informant C	Livestock Group Member	Livestock feeding and maintenance	2 years
Informant D	Sorghum Cultivation Member	Sorghum farming	1 years
Informant E	Waste Management Member	Tempeh waste collection and processing	1 years

RESULTS AND DISCUSSION

Results

The research results show that the community empowerment process based on tempeh waste management at Padepokan Siloka Smart developed through complex social dynamics, involving local leadership, waste-based economic innovation, and collective learning within the community. Thematic analysis yielded three core findings that illustrate the empowerment transition from dependency to more adaptive participation.

1. Community Participation is Instrumental and Influenced by Economic Vulnerability

The first finding indicates that community participation in the early stages of the program was still instrumental, relying on short-term economic incentives and not yet fully driven by collective awareness. This condition is related to the community's limited participatory capacity and daily economic pressures that influence residents' decisions to participate in the empowerment program. The community leader explained that the program planning initiative was still dominated by him because most residents were not used to expressing ideas or designing activities independently.

> "The planning has to come from me first... it's difficult for residents to contribute ideas because many of them are elderly." (Informant A)

Residents involved in waste management also expressed their dependence on incentives.

> "If there's a daily wage, they participate. If not, they usually withdraw." (Informant E)

A livestock group member added that some residents were more interested in jobs with direct income.

> "People here are more comfortable as long as there's a daily wage, for example, 50,000 Rupiah. Then they're willing to work." (Informant B)

Furthermore, the study also found resistance to the agriculture and livestock sectors, especially from the younger generation, who view these jobs as less attractive than formal employment.

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> "Young people are more confident working at Indomaret or factories... they say farming or livestock farming is dirty and the results are unclear." (Informant A)

This finding indicates that community participation is still influenced by short-term economic factors and social perceptions of the type of work. Therefore, in the initial stages of empowerment, a more directive approach from community leaders is required.

2. Innovation in Managing Tempeh Waste into Animal Feed as a Driver of Socio-Ecological Transformation

The second finding shows that the innovation of processing tempeh waste into animal feed was a significant turning point in the community empowerment process. Tempeh waste, previously a source of environmental pollution, was successfully processed into an alternative feed source for community livestock. The community leader explained that this innovation arose from an effort to find a solution to the waste problem that often led to environmental conflicts.

> "We finally processed the unpleasant-smelling tempeh waste into animal feed. So tempeh producers no longer have to worry about waste." (Informant A)

The waste manager also described changes in waste management practices in the community.

> "Previously, this waste was dumped carelessly and caused a commotion. Now we collect it, ferment it, and then use it as feed." (Informant E)

For livestock groups, this innovation provides significant economic benefits by reducing production costs.

> "Feed costs are now much lower because the waste is the main ingredient." (Informant B)

The success of this innovation not only impacts the economic and environmental aspects but also increases the community's social legitimacy, attracting the attention of various parties to collaborate.

> "Stakeholders come to us on their own when they see the business progressing... yesterday, the Japanese Chamber of Commerce and Industry (Kadin) and the French came to inspect our animal feed." (Informant A)

This finding demonstrates that local waste-based innovation can serve as a catalyst for social transformation, while also strengthening collaborative networks with external actors.

3. Adaptive Leadership and Hybrid Livelihood Strategies Encourage Collective Learning and Sustainable Participation

The third finding indicates that the sustainability of community empowerment is strongly influenced by adaptive leadership based on hands-on practice and economic strategies that balance short-term and long-term needs. Community leaders employ an experiential learning approach, where residents learn through direct experience in the field.

> "The training isn't technical guidance... but in the field. I have to demonstrate first, then the residents join in." (Informant A)

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Members of the livestock group found this method easier to understand than formal training.

> "Learning from direct observation is more ingrained than in a classroom. The leader first teaches them how to make feed." (Informant C)

To maintain sustainable participation, the community also developed a hybrid livelihood strategy, combining livestock farming as a long-term investment with sorghum cultivation, which generates income more quickly.

> "Sorghum is harvested in four months... so while waiting for the livestock, residents still earn income." (Informant D)

This strategy helped reduce economic pressure on residents, allowing them to remain involved in community activities. Over time, the tangible success of livestock farming and waste management activities began to build community confidence.

> "I didn't know about fermentation before. Now I can make good feed." (Informant E)

These findings indicate that community empowerment develops through a gradual, collective learning process, supported by adaptive leadership and contextual economic strategies.

Overall, the research findings indicate that community empowerment at Padepokan Siloka Smart developed through a transitional process, starting with dominant leadership, relevant local innovations, and adaptive economic strategies. Initially weak community participation gradually increased through the introduction of concrete benefits, practice-based learning, and the strengthening of social networks. This approach demonstrates that empowerment does not always begin with spontaneous participation but requires adaptive local leaders, contextual innovations, and transitional income mechanisms to ensure sustainability. The thematic analysis identified three core themes that explain the dynamics of community empowerment. A summary of these themes and supporting interview excerpts is presented in Table 3.

Table 3. Summary of Themes and Supporting Quotes

Core Theme	Key Finding	Supporting Quote
Instrumental Community Participation	Participation is still driven by short-term economic incentives and limited community initiative.	"Kalau ada upah harian, mereka ikut. Kalau tidak ada, biasanya mundur duluan." (Informant E)
Circular Waste Innovation as Transformation Driver	Tempeh waste is transformed into livestock feed, reducing pollution and creating economic benefits.	"Limbah tempe akhirnya kami olah jadi pakan ternak." (Informant A)
Adaptive Leadership and Hybrid Livelihood Strategy	Practice-based leadership and the integration of sorghum and livestock support sustainable participation.	"Pelatihannya di lapangan… saya contohkan dulu baru warga ikut." (Informant A)

Discussion

The findings of this study show that community empowerment within a waste-based circular livelihood system develops through a gradual and adaptive process. Rather than emerging from immediate collective participation, the initiative initially evolved through leader-driven actions that responded to environmental problems and economic vulnerabilities within the tempe-producing community. Over time, these initiatives facilitated the transformation of waste into productive resources, the development of

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adaptive livelihood strategies, and the gradual strengthening of collective learning among community members. Building on these findings, this discussion examines three key dimensions of the empowerment process: instrumental participation shaped by economic needs, circular waste innovation as a driver of socio-ecological transformation, and the role of adaptive leadership and hybrid livelihood strategies in fostering sustainable community participation.

1. Instrumental Participation and Economic Vulnerability

The findings of this study indicate that community participation in the initial stage of the empowerment process tends to be instrumental and strongly influenced by short-term economic needs. Community members primarily engage in waste management and livestock activities because they expect direct economic benefits rather than being motivated by ecological awareness or long-term collective commitments. In contexts characterized by economic vulnerability, participation often emerges from pragmatic considerations where individuals prioritize activities that provide immediate income or tangible financial advantages.

Empirical evidence from the research site shows that some members initially withdrew from the livestock program due to the long investment cycle required for economic returns. The livestock scheme, which required waiting periods of two to three years for profit realization, created economic pressure for participants who relied on daily income for their livelihoods. This condition illustrates how livelihood insecurity shapes the nature of community participation and limits the capacity for long-term collective engagement.

This finding aligns with the concept of instrumental participation in community empowerment theory, which suggests that early forms of participation are frequently driven by pragmatic benefits before evolving into deeper forms of engagement (Cornwall, 2008; Zimmerman, 2000). In economically constrained communities, participation often begins as a rational survival strategy rather than as an ideological commitment to collective goals.

However, instrumental participation should not necessarily be interpreted as a limitation of empowerment processes. Instead, it can serve as an initial entry point for broader social engagement. As community members experience the tangible benefits of collective activities, opportunities emerge for deeper involvement and stronger community ownership. In this sense, instrumental participation represents a transitional stage that may gradually evolve toward more sustainable forms of collective participation.

2. Circular Waste Innovation as a Driver of Socio-Ecological Transformation

Another important finding of this study is that local innovation in managing soybean pulp waste from tempe production into livestock feed functions as a catalyst for socio-ecological transformation within the community. Prior to the intervention, soybean pulp waste was disposed of indiscriminately, creating environmental pollution, unpleasant odors, and social tensions within the neighborhood. The waste problem even resulted in legal sanctions due to community complaints.

The transformation of this waste into livestock feed represents a practical application of circular economy principles at the community level. Rather than being treated as an environmental burden, waste materials were revalorized and integrated into local production systems. This approach reflects the circular economy paradigm, which

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emphasizes extending the lifecycle of resources through reuse, recycling, and regeneration (Geissdoerfer et al., 2017; Kirchherr et al., 2017).

Beyond its environmental benefits, this innovation also generated new economic opportunities. The establishment of community-based livestock facilities reduced feed costs, increased livestock productivity, and diversified household income sources. At the same time, the initiative strengthened community cooperation through shared responsibilities in waste collection, livestock management, and agricultural activities.

Moreover, the innovation contributed to the development of a community-based social enterprise model in which economic activities were integrated with social and cultural practices. Livestock resources were redistributed during religious and community events such as Eid al-Adha, Mauludan, and other communal celebrations. This integration demonstrates how waste-based circular economy initiatives can simultaneously generate environmental benefits, economic value, and social cohesion.

These findings support previous studies indicating that community-based circular economy practices can act as catalysts for social transformation when waste-based innovations generate tangible economic value and encourage collective participation (Schroeder et al., 2019). The case examined in this research therefore illustrates how environmental problem-solving can become a strategic entry point for strengthening local economic resilience and community solidarity.

3. Adaptive Leadership, Hybrid Livelihood Strategies, and Collective Learning

The study also reveals that adaptive leadership plays a crucial role in facilitating the transition from instrumental participation toward more sustainable forms of collective engagement. In the early stage of the empowerment initiative, the program was largely initiated and coordinated by the community leader due to limited participatory capacity among members, particularly because many participants were elderly and had limited experience in entrepreneurial planning.

This leader-driven initiation functioned as a catalytic mechanism that mobilized community members and introduced innovative solutions to local environmental problems. The role of leadership in this context aligns with the concept of adaptive leadership, which emphasizes the ability of leaders to facilitate community learning and adaptation in complex social situations (Heifetz, Grashow, & Linsky, 2009).

Over time, the leadership dynamic evolved from a directive approach toward a more collaborative learning process. Community members gradually developed technical knowledge and practical skills through direct involvement in livestock management, waste processing, and agricultural activities. Training and capacity building occurred primarily through experiential learning mechanisms, where knowledge was constructed through practice, trial-and-error, and shared reflection rather than through formal training programs.

An important adaptive strategy in sustaining participation was the integration of hybrid livelihood mechanisms. To address the long return cycle of livestock investment, the program introduced sorghum cultivation as a short-cycle agricultural activity with a harvest period of approximately four months. This short-term income source helped maintain economic stability among participants while waiting for long-term livestock profits. This hybrid livelihood strategy demonstrates how empowerment programs must balance short-term livelihood needs with long-term economic development. As noted in sustainable livelihood literature, diversification strategies enable communities to reduce

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economic risk and enhance resilience in uncertain conditions (Scoones, 2015). In addition to economic benefits, the empowerment process also strengthened social capital within the community. Collective activities in livestock farming and agricultural production fostered cooperation, trust, and mutual support among members. Social networks expanded over time, attracting collaborations with universities, government institutions, and other stakeholders interested in developing waste-based innovations.

Overall, these findings suggest that adaptive leadership, hybrid livelihood strategies, and collective learning function as interconnected mechanisms that support the transition from leader-driven action toward broader community participation. Through gradual processes of social learning and economic adaptation, communities develop the capacity to manage circular economy initiatives more independently and sustainably.

CONCLUSION

Fundamental Finding: This study demonstrates that community empowerment in circular economy–based waste management develops through an adaptive transitional process rather than emerging from immediate participatory readiness. In the case of Padepokan Siloka SMART, empowerment initially evolved through leader-driven initiation due to limited participatory capacity and economic vulnerability among community members. Adaptive leadership functioned as a catalytic mechanism that mobilized participation and facilitated the transformation of soybean pulp waste into a productive resource through integrated livestock and sorghum-based livelihood strategies. Over time, experiential learning and social interaction enabled community members to gradually develop technical skills, strengthen cooperation, and move toward broader collective engagement. **Implication:** These findings highlight that effective community empowerment requires not only circular economy innovation but also adaptive leadership and hybrid livelihood strategies capable of stabilizing participation in economically vulnerable contexts. The study also emphasizes that empowerment should be understood as a staged learning process in which leadership initially scaffolds participation before collective capacity and autonomy gradually emerge. **Limitation:** This research is limited by its single-site qualitative design and the absence of systematic measurement of long-term economic impacts and social capital development. **Future Research:** Future studies should employ longitudinal and mixed-method approaches to examine governance transitions, quantify economic benefits, and further validate the adaptive empowerment model across different community contexts.

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*** Herlina Siregar (Corresponding Author)**
Sultan Ageng Tirtayasa University,
Jl. Raya Palka KM 3, Sindangsari, Pabuaran, Kabupaten Serang, Provinsi Banten, Indonesia
Email: herlina.siregar@untirta.ac.id

Ahmad Fauzi
Sultan Ageng Tirtayasa University,
Jl. Raya Palka KM 3, Sindangsari, Pabuaran, Kabupaten Serang, Provinsi Banten, Indonesia
Email: fauzipls@untirta.ac.id

Fitri Pertiwi
Sultan Ageng Tirtayasa University,
Jl. Raya Palka KM 3, Sindangsari, Pabuaran, Kabupaten Serang, Provinsi Banten, Indonesia
Email: fitri.pertiwi@untirta.ac.id

Ahmad Rizaldi
Sultan Ageng Tirtayasa University,
Jl. Raya Palka KM 3, Sindangsari, Pabuaran, Kabupaten Serang, Provinsi Banten, Indonesia
Email: ahmad.rizaldi@untirta.ac.id