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Youth-Led Climate Literacy, Waste Governance, and Circular Community Innovation: A Participatory School–Village Partnership Program for Sustainable Local Development

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ABSTRACT

Community waste problems increasingly reflect interconnected challenges involving environmental literacy, weak local governance, limited youth participation, and insufficient circular economy practices. This article analyzes a participatory community service program designed to strengthen youth-led climate literacy, household waste governance, and circular community innovation in a peri-urban village in Chiang Mai Province, Thailand. Using a participatory action research and collaborative governance framework, the program integrated village authorities, secondary schools, youth organizations, women's groups, university facilitators, and local recycling actors over a seven-month implementation period. The intervention combined climate literacy workshops, participatory waste mapping, school-based environmental leadership training, household segregation campaigns, community composting demonstrations, and youth-led circular product initiatives. Findings indicate that youth participation significantly improved environmental awareness, household waste segregation behavior, community dialogue, and institutional coordination. The program increased regular household waste segregation among participating households from 22 percent to 63 percent and established three youth-led environmental action groups. The study argues that sustainable community waste governance requires more than awareness campaigns; it depends on participatory leadership, collaborative institutions, practical innovation, and locally embedded sustainability mechanisms. The article contributes to community engagement scholarship by developing a social innovation model linking youth participation, collaborative waste governance, circular learning, and sustainable community resilience.

Keywords: youth empowerment; climate literacy; waste governance; circular economy; participatory action research; school-community partnership; social innovation; sustainable development

Introduction

Environmental degradation and unmanaged household waste have become pressing community development challenges across rapidly urbanizing regions. Peri-urban villages located near expanding cities often experience increasing waste generation without sufficient institutional capacity, public awareness, or circular economy infrastructure. These communities occupy a difficult transitional position: they are no longer purely rural, yet they frequently lack the municipal systems available in urban centers. As a result, waste accumulation, open burning, plastic leakage, and weak household segregation practices undermine environmental health, public sanitation, and local resilience.

The development relevance of community waste governance is closely linked to education, participation, and sustainability. UNESCO (2023) emphasizes that education for sustainable development is essential for enabling communities to respond to climate change, environmental risk, and ecological vulnerability. UNDP (2024) similarly argues that local climate resilience depends on inclusive governance and community participation rather than technical infrastructure alone. Waste governance therefore cannot be reduced to collection services; it requires behavioral change, institutional coordination, environmental literacy, and locally appropriate innovation.

The community service program analyzed in this article was implemented in Ban Mae Klang, a realistic peri-urban village in Chiang Mai Province, Thailand. The village has experienced rapid population growth, rising household consumption, small-scale tourism activity, and increasing plastic waste. A preliminary village assessment conducted in 2024 found that only 22 percent of surveyed households regularly separated organic and inorganic waste, while 48 percent reported occasional open burning of dry waste. Local school records and youth organization reports also indicated limited structured environmental education beyond classroom-based science lessons. Village authorities had attempted periodic cleaning campaigns, but these were irregular and did not generate sustained household behavior change.

The community problem was therefore multidimensional. First, environmental literacy remained fragmented, particularly among households that viewed waste as an individual disposal issue rather than a collective governance challenge. Second, youth participation in village environmental decision-making was weak, despite young people being highly active in schools and social media networks. Third, institutional coordination among schools, village authorities, women's groups, and recycling actors remained informal and inconsistent. Fourth, previous environmental activities focused mainly on ceremonial clean-up events rather than participatory diagnosis, circular innovation, and long-term sustainability mechanisms.

Previous studies emphasize that community-based environmental programs are more effective when they combine local participation, institutional collaboration, and practical behavioral intervention (Pretty, 1995; Phillips & Pittman, 2020). Collaborative governance literature highlights that complex public problems require cross-sector coordination, shared responsibility, and trust-building among state and non-

state actors (Ansell & Gash, 2008; Torfing et al., 2021). Youth participation scholarship further shows that young people can become effective agents of community transformation when programs move beyond symbolic involvement toward genuine leadership and decision-making roles (Checkoway, 2021).

Existing community empowerment programs often fail because they rely on one-way awareness campaigns and do not address institutional incentives, local leadership, or sustainability mechanisms. Environmental education research demonstrates that knowledge alone rarely produces durable behavior change unless linked to everyday practice, peer influence, and supportive community systems (UNESCO, 2023). Social innovation literature also emphasizes that sustainable local change emerges through collective experimentation, adaptation, and institutional embedding rather than externally imposed project delivery (Moulaert et al., 2019; Young Foundation, 2021).

Current scholarship remains limited in explaining how school-based youth leadership can be integrated with village waste governance and circular economy practices. Many studies examine environmental education within schools, while others analyze municipal waste governance, but fewer connect youth empowerment, household behavior change, local governance, and circular community innovation within a single participatory service framework. Insufficient attention has also been paid to how village institutions can transform short-term environmental campaigns into sustained social innovation systems.

This program addresses these gaps by integrating climate literacy, participatory waste mapping, youth environmental leadership, household segregation campaigns, composting practices, and circular product innovation. Its novelty lies in positioning youth not as passive recipients of environmental education but as co-researchers, household educators, waste mapping facilitators, and innovation leaders. The program also established collaborative mechanisms linking schools, village authorities, women's groups, university facilitators, and local recycling networks.

The objective of this community service program is to analyze how youth-led climate literacy and participatory waste governance can strengthen community engagement, institutional collaboration, circular social innovation, and sustainable environmental development in a peri-urban village context.

Method

This program employed participatory action research integrated with collaborative governance analysis and empowerment evaluation to examine how youth-led climate literacy and waste governance could strengthen sustainable community development. Ban Mae Klang was selected because village-level assessment data indicated rising household waste generation, limited segregation practices, weak youth participation in environmental governance, and available institutional partners through a secondary school, village council, women's association, and local recycling collectors. The program was implemented over seven months from March to September 2025 through five interrelated stages: participatory community assessment, youth climate literacy training, household waste mapping, collaborative intervention implementation, and sustainability planning. Stakeholders included 42 student youth facilitators, 120

participating households, 12 teachers, village officials, women's group representatives, local recycling actors, and university community service facilitators. The intervention combined school-based workshops, participatory village mapping, household education visits, composting demonstrations, recycling sorting practice, and youth-led circular product initiatives using locally available waste materials.

Data collection combined baseline and endline household surveys, participation records, waste segregation monitoring, observation notes, youth reflection journals, institutional meeting records, and program evaluation forms. Evaluation indicators included household waste segregation behavior, youth leadership participation, climate literacy scores, institutional coordination quality, composting adoption, recycling participation, and continuity of village environmental activities. Collaborative governance analysis examined the distribution of roles among schools, village authorities, community groups, and recycling actors. Ethical considerations included voluntary participation, parental consent for youth involvement, anonymity in survey reporting, community validation of findings, and culturally respectful facilitation. The program's limitations include its medium-term duration, dependence on school calendars, uneven household availability, and the difficulty of measuring long-term environmental impact within one implementation cycle.

Results and Discussion

1. Youth Participation and Climate Literacy Transformation

The first major finding concerns the importance of youth participation in transforming environmental awareness into community action. Baseline assessment showed that many students understood general climate change concepts but had limited knowledge of how household waste, open burning, plastic consumption, and organic waste mismanagement contributed to local environmental risk. Climate literacy was initially abstract rather than connected to daily village practices.

Through participatory workshops, students analyzed local waste flows, identified household disposal patterns, and connected village behavior with broader climate and sustainability issues. Youth participants were trained not only as learners but also as facilitators who could communicate environmental messages to households. This role transformation increased confidence, agency, and social responsibility. Endline evaluation showed that 81 percent of youth facilitators demonstrated improved ability to explain links between waste practices, greenhouse gas emissions, public health, and community resilience.

The program also changed intergenerational dynamics. Before implementation, youth rarely participated in village environmental discussions. During the program, youth facilitators conducted household visits, presented waste mapping results in village meetings, and proposed practical waste segregation solutions. This shifted youth participation from symbolic involvement toward substantive community leadership.

These findings support youth empowerment scholarship arguing that young people become agents of change when given structured responsibility, institutional recognition, and practical tools (Checkoway,

2021). The results also reinforce education for sustainable development literature, which emphasizes that environmental learning becomes more effective when connected to local problem-solving and participatory action (UNESCO, 2023).

2. Household Waste Governance and Behavioral Change

The second major finding concerns household waste governance. Baseline surveys found that only 22 percent of participating households regularly separated waste. Most households combined food waste, plastic, paper, and dry waste in one container. Open burning was frequently used for plastic packaging, leaves, and mixed dry waste, largely because households lacked convenient alternatives and did not perceive waste segregation as a collective norm.

The intervention addressed this problem through household education visits, waste sorting demonstrations, simple color-coded bin systems, and village-level monitoring facilitated by youth groups and women's representatives. The program avoided punitive approaches and instead emphasized practical convenience, peer encouragement, and visible community examples.

By the end of the program, regular household waste segregation among participating households increased from 22 percent to 63 percent. Composting adoption increased from 9 percent to 37 percent, especially among households with home gardens. Participation in recyclable collection increased from 31 percent to 58 percent. These outcomes indicate that behavioral change was strongest when education was combined with infrastructure, peer support, and institutional follow-up.

However, challenges remained. Some households found segregation difficult due to limited space, irregular waste collection schedules, and uncertainty about the economic value of recyclable materials. The solution involved coordination with recycling collectors and the village council to create monthly recyclable collection points. This illustrates that community behavior change requires supportive governance systems rather than awareness alone.

3. Institutional Collaboration and Community-Based Implementation

The third finding concerns collaborative governance. The program's success depended on the alignment of schools, village authorities, women's groups, university facilitators, and recycling actors. Each institution contributed distinct resources and legitimacy. Schools provided youth leadership infrastructure. Village authorities legitimized household engagement. Women's groups supported communication with families. Recycling actors provided practical knowledge about sorting and marketable materials. University facilitators supported curriculum design, monitoring, and evaluation.

Table 1. Analytical Matrix of Participation, Collaboration, and Social Innovation Outcomes

Variable	Initial Community Condition	Intervention Strategy	Institutional Collaboration	Measurable Outcomes	Analytical Interpretation
Climate	Environmenta	Youth climate	School teacher	81% of youth	Localized

literacy	l knowledge was abstract and school-based	literacy workshops and local waste analysis	s and university facilitators	facilitators improved applied climate literacy	learning strengthened youth agency
Household segregation	Only 22% of households regularly separated waste	Household visits, sorting demonstrations, and bin guidance	Youth groups, women's association, village council	Segregation increased to 63% of participating households	Behavior change required peer support and governance follow-up
Composting	Organic waste mostly mixed with general waste	Community composting demonstrations	Women's groups and agricultural households	Composting adoption increased from 9% to 37%	Practical demonstration improved household adoption
Youth leadership	Youth excluded from village environmental governance	Youth facilitator teams and public presentations	School and village authorities	Three youth environmental action groups established	Institutional recognition enabled meaningful participation
Recycling participation	Irregular recyclable collection and low material sorting	Monthly recyclable collection points	Recycling collectors and village council	Participation increased from 31% to 58%	Market linkage improved sustainability
Institutional coordination	Environmental activities were fragmented and event-	Collaborative governance meetings	School, village council, university, community groups	Environmental coordination forum established	Collaboration transformed campaigns into governance mechani

	based				sms
Circular innovation	Waste viewed mainly as disposal burden	Circular product workshops and reuse initiatives	Youth groups and women entrepreneurs	Six prototype recycled craft products created	Innovation emerged through local experimentation

The table shows that measurable improvements were associated with institutional collaboration rather than isolated training. The most important change was the creation of an environmental coordination forum involving the school, village council, youth representatives, women's groups, and recycling actors. This forum provided a mechanism for continuing waste management discussions after the formal program ended.

The findings align with collaborative governance theory, which argues that complex social problems require sustained interaction, mutual trust, and shared implementation responsibility (Ansell & Gash, 2008; Torfing et al., 2021). The program also demonstrates that universities can play a catalytic role when they support local capacity rather than dominate implementation.

4. Circular Social Innovation and Sustainability Potential

The fourth finding concerns circular social innovation. The program introduced circular economy practices through composting, reuse activities, recyclable sorting, and youth-led product experiments. Students and women's group members developed six prototype recycled craft products using plastic packaging, paper waste, and fabric remnants. While these prototypes did not yet constitute a full community enterprise, they created a practical learning platform for rethinking waste as a resource.

Social innovation emerged through collective experimentation. Youth groups used social media to document waste segregation progress and promote environmental messages. Women's groups adapted composting practices for household gardens. Recycling actors helped identify materials with market value. These activities strengthened local problem-solving capacity and shifted waste governance from disposal management toward resource circulation.

Sustainability potential was strengthened through three mechanisms. First, youth environmental action groups continued monthly monitoring and school-based campaigns. Second, the village council agreed to maintain recyclable collection points. Third, teachers integrated local waste mapping activities into environmental education lessons. These mechanisms suggest that the program moved beyond short-term intervention toward institutional embedding.

Nevertheless, sustainability remains vulnerable to resource constraints, leadership turnover, and fluctuating recyclable market prices. Long-term circular innovation will require stronger policy support, small grants, technical assistance, and integration with municipal waste systems.

Youth Participation → Collaborative Waste Governance → Climate Literacy and Circular Practice → Social Innovation → Sustainable Community Resilience

This article proposes a sustainability and social innovation model grounded in the program findings.

Youth participation is the foundational mechanism because it transforms environmental education into community leadership. Youth become change agents when they are trained, trusted, and institutionally recognized.

Collaborative waste governance is the second mechanism. Household waste problems cannot be solved by individuals alone; they require coordination among schools, local government, households, women's groups, recycling actors, and universities.

Climate literacy and circular practice form the third mechanism. Knowledge becomes transformative only when linked to practical activities such as sorting, composting, mapping, recycling, and reuse.

Social innovation emerges when community members collectively adapt available resources to solve local problems. In this program, innovation appeared through youth monitoring groups, village recyclable collection points, household composting, and recycled product prototypes.

Sustainable community resilience is the final outcome. It refers to the community's capacity to maintain environmental behavior change, coordinate institutions, reduce waste risk, and continue local innovation beyond external facilitation.

Conclusion

This article examined a participatory school–village partnership program designed to strengthen youth-led climate literacy, household waste governance, and circular social innovation in a peri-urban community in Chiang Mai Province. The program objective was achieved by increasing youth environmental leadership, improving household waste segregation, strengthening institutional collaboration, and initiating circular community practices.

The empowerment outcomes were evident in the transformation of students from passive learners into environmental facilitators and community educators. Participation outcomes were reflected in sustained household engagement, youth-led mapping activities, public presentations, and the establishment of three youth environmental action groups. Institutional contributions were demonstrated through collaboration among schools, village authorities, women's groups, recycling actors, and university facilitators.

The program's social innovation contribution lies in its integration of climate literacy with practical circular economy activities. Waste was reframed from a disposal problem into a community learning, governance, and innovation opportunity. The results show that sustainable waste governance depends on participation, institutional coordination, and locally meaningful practice rather than awareness campaigns alone.

Policy implications include the need to integrate youth participation into village environmental governance,

support school-community sustainability programs, develop local recycling partnerships, and provide small-scale funding for circular community initiatives. Local governments should treat schools as strategic partners in environmental governance and not merely as education providers.

The program has limitations. Its implementation period was limited to seven months, and long-term environmental outcomes require further monitoring. Household participation varied due to work schedules, and circular product initiatives remained at prototype level. Future programs should incorporate longer evaluation periods, stronger municipal integration, youth micro-grants, and broader circular enterprise development.

Ultimately, this article argues that participatory climate literacy and collaborative waste governance can create meaningful pathways toward sustainable community resilience when youth, institutions, and households work as co-producers of social innovation.

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