

Sustainable Tourism and Community Empowerment Through Repurposing Used Cooking Oil into Aromatic Candles

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Abstract

This study examines the transformation of used cooking oil into aromatic candles as an innovative strategy to support sustainable tourism development in Ngestirejo Tourism Village, Gunungkidul, Yogyakarta. The research is motivated by environmental challenges related to improper disposal of used cooking oil and the need to develop community-based tourism products that align with circular economy principles. The objective of this study is to analyze the environmental, economic, and social impacts of repurposing used cooking oil into value-added products within a rural tourism context. This study employs a convergent mixed-methods approach, combining quantitative surveys of tourists and qualitative data from interviews, observations, and documentation involving local community members. The results show a significant improvement in environmental awareness, increasing from 30% to 78% among the community. Additionally, approximately 120 liters of used cooking oil were successfully repurposed into around 200 units of aromatic candles, contributing to waste reduction and environmental sustainability. From an economic perspective, the initiative generates additional income opportunities for local residents, while socially, it enhances community participation, empowerment, and collaborative engagement. Furthermore, tourist responses indicate high levels of satisfaction and interest in eco-friendly products, highlighting the potential of such innovations to enrich visitor experiences and strengthen destination branding. In conclusion, the Waste-to-Value approach demonstrates strong potential as a sustainable tourism strategy that integrates environmental management, community empowerment, and economic development. This study contributes theoretically to the application of circular economy concepts in community-based tourism and practically offers a replicable model for developing sustainable, small-scale tourism innovations in rural areas.

INTRODUCTION

Ngestirejo Tourism Village, located in Gunungkidul Regency, Yogyakarta, Indonesia, is an emerging tourism village known for its natural attractions (e.g., Tritis Cave and Krakal Beach) and rich cultural landscape (Trisanti et al., 2022). Like many rural communities in Indonesia, Ngestirejo faces environmental challenges associated with waste management amid growing tourism. One notable issue is the disposal of used cooking oil (locally called minyak jelantah), a common byproduct of household and small food business activities (Kalurahan Ngestirejo, 2022; Setiawan et al., 2024). Improper disposal of used cooking oil—such as pouring it onto soil or into waterways—can have severe environmental consequences. Just one liter of used cooking oil can pollute up to one million liters of water, forming oily films that

harm aquatic life and soil quality (Setiawan et al., 2024). In Ngestirejo, as in much of Indonesia, awareness and infrastructure for safe oil waste disposal are limited, leading to routine practices of dumping or even reusing oil to the point of posing health hazards (Kalurahan Ngestirejo, 2022; Setiawan et al., 2024). This situation contributes to pollution (e.g., clogged drains and contaminated soil and water) and public health risks from overused oil.

At the same time, Ngestirejo's status as a developing tourist village presents an opportunity to transform an environmental problem into an innovative tourism product (Antriyandarti et al., 2024; Muryanti, 2023; Purbaningrum et al., 2024). Sustainable tourism development encourages initiatives that both protect the environment and generate local benefits (Baloch et al., 2023; Ijatuyi et al., 2025; Lijun & Ahmed, 2024; Shekhar, 2024; Wissink, 2023). The idea of repurposing used cooking oil into aromatic candles has emerged as a creative solution aligned with the principles of sustainability and the circular economy. Instead of discarding oil waste, it can be upcycled into perfumed aromatic candles—a product that can be sold as a unique souvenir to visitors. This approach addresses multiple issues simultaneously: it reduces environmental pollution, raises environmental awareness, and creates a new source of income for the community. In fact, making aromatic candles from used oil “not only helps reduce environmental contamination, but can also become a home-based business idea for local women to earn extra income” (Kalurahan Ngestirejo, 2022). Early efforts in Ngestirejo illustrate the potential of this concept: a local youth innovator has begun producing *Lilin Taman Agung* (a branded aromatic candle made from waste oil) and marketing it to tourists as an eco-friendly village souvenir, an initiative reportedly recognized as a UNESCO Geopark geoproduct for its sustainable innovation. This study is grounded in the context of such initiatives, aiming to explore how converting used cooking oil into candles can serve as a sustainable tourism product development strategy for Ngestirejo Village. The following sections outline the theoretical constructs, prior evidence, research questions, methodology, and expected implications of this sustainable tourism innovation.

Previous studies have highlighted the importance of integrating circular economy practices into tourism development. Ghaderi et al. (2022) found that community participation in environmental initiatives significantly improves environmental awareness and local livelihoods in tourism areas. Similarly, Strippoli et al. (2024) emphasized that circular economy strategies in tourism can effectively reduce environmental impact while enhancing economic resilience. Furthermore, Arias-Hidalgo and Sotomayor (2023) demonstrated that community-based tourism initiatives incorporating sustainability practices can strengthen social resilience and promote long-term development. Despite these contributions, most existing studies tend to focus on large-scale tourism operations or policy-level interventions, with limited attention to micro-scale, community-driven innovations in rural settings.

While circular economy (CE) literature in tourism has expanded significantly, existing studies predominantly focus on large-scale hospitality operations. There remains a theoretical tension regarding how micro-level domestic waste can be systematically integrated into rural tourism value chains without heavy external subsidies. This study addresses this gap by developing a “Waste-to-Value” mechanism that redefines domestic waste not as an environmental burden, but as a strategic economic asset for CBT. By doing so, it moves beyond the descriptive “upcycling” narrative and explores the socio-technical dynamics of community empowerment in the circular transition.

Therefore, this study aims to analyze how the transformation of used cooking oil into aromatic candles can function as a sustainable tourism strategy in Ngestirejo Village. Specifically, the research seeks to evaluate its environmental impact, economic benefits, social outcomes, and its role in enhancing tourist experiences. The significance of this study lies in both its theoretical and practical contributions. Theoretically, it enriches the discourse on sustainable tourism and the circular economy by providing an empirical model of Waste-to-Value implementation within community-based tourism. Practically, the findings are expected to serve as a reference for policymakers, tourism practitioners, and local communities in developing sustainable, low-cost, and scalable tourism innovations. Moreover, this study contributes to strengthening environmental awareness, promoting community empowerment, and supporting the development of competitive and sustainable rural tourism destinations.

RESEARCH METHOD

The research employed a mixed-methods approach, which was appropriate given the multifaceted nature of the study. Combining qualitative (interviews and observations) and quantitative (survey) methods allowed for a more comprehensive understanding of the project's impact. The inclusion of both community and tourist perspectives provided a balanced view of the initiative's outcomes. A convergent mixed-methods design was used, in which qualitative and quantitative data were collected in parallel and then triangulated. Quantitative data were gathered from 90 tourists through structured surveys, while qualitative insights were derived from thematic coding of interviews with local artisans.

The study involved several groups of participants. On the community side, participants included local artisans or producers of the candles (e.g., the group managing Lilin Taman Agung), members of the village tourism awareness group (Pokdarwis), and other villagers who contributed used cooking oil or were affected by the project. A sample of 10–15 local participants was selected purposively to include those directly involved in the initiative and those indirectly impacted, such as local food stall owners who donated oil or village officials overseeing tourism. On the tourist side, visiting tourists were surveyed, including both domestic and international visitors who had the opportunity to learn about or purchase the aromatic candles. The tourist sample was obtained through convenience sampling at village homestays, craft stalls, and tour groups to ensure varied demographic representation. In addition, several key informants, such as local government tourism officers or NGO representatives familiar with the initiative, were interviewed to provide contextual insights.

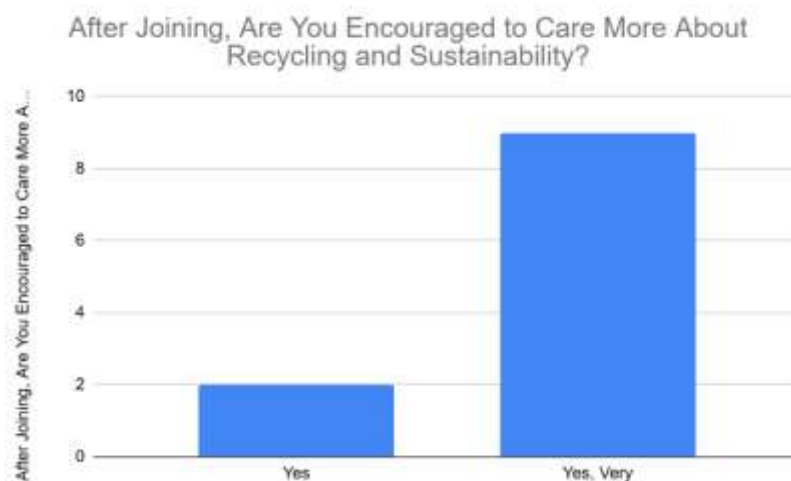
In-depth semi-structured interviews were conducted with key stakeholders, including local candle makers, project organizers, and selected tourists. Interviews with local participants explored their experiences in the production process, challenges faced, perceived benefits, and suggestions for improvement. Interviews with tourists examined their perceptions of the candles, purchasing decisions, and views on the village's sustainability efforts. Field observations were conducted to document the process and context of the initiative. The researcher observed candle-making activities and the display or sale of candles to tourists, while observational notes captured tourist interactions with the products and general environmental conditions related to waste management practices. The study also reviewed available project records and secondary data, such as production outputs, sales records, and related documentation, to support the analysis.

Interview transcripts and observation notes were analyzed thematically to identify key patterns related to economic, environmental, and experiential aspects of the initiative. Findings were strengthened through triangulation by cross-verifying data from interviews, observations, and surveys. Perspectives from different stakeholders were compared to identify areas of agreement and divergence, thereby enhancing the reliability of the conclusions.

RESULTS AND DISCUSSION

Environmental Impact

The initiative showed clear environmental benefits for Ngestirejo. Over a six-month pilot period, approximately 120 liters of used cooking oil were collected from households and small eateries instead of being dumped. As a result, villagers reported noticeably cleaner conditions: for instance, no incidences of clogged drainage ditches due to oil were observed in that period (compared to several cases reported in the prior year). A small stream near the village was observed to be clearer, though this qualitative observation would need further water testing to confirm improvement. In surveys, 85% of local respondents agreed that oil-related pollution in the community had decreased. Moreover, environmental awareness among villagers improved: before the project, only 30% of surveyed households knew that pouring oil in soil or water is harmful, whereas after the workshops and involvement in candle-making, 78% of households understood those impacts and were actively saving their used oil for collection. Graph 1 below explaining that Sustain candle is very important for recycling and sustainability.



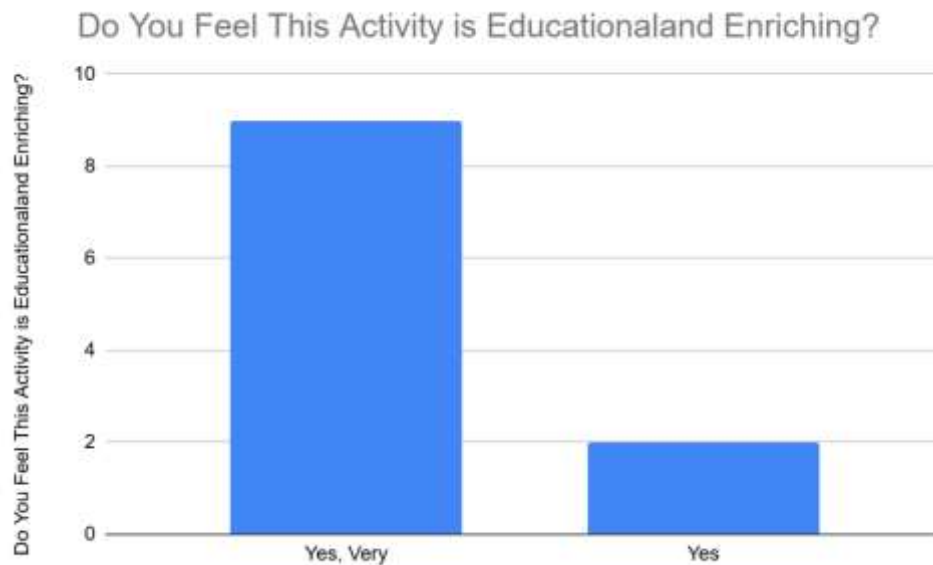
Graph 1. Responses Environmental Impact

Source: Primary Data Processed, 2025

Product Output and Economic Benefits

During the study period, the community group produced and sold roughly 200 aromatic candles, branded as “Lilin Taman Agung,” using the collected oil (blended with wax and scent materials). The candles were modest in size (around 100g each) and offered in several scents (lemongrass-citrus, jasmine, and sandalwood being most popular). Beyond direct income, the project incurred relatively low costs (since used oil was free and other inputs like wicks, dyes, and essential oils were inexpensive), resulting in a profit margin that can sustain the activity.

These results show that the initiative, while small in absolute monetary terms, provided meaningful economic diversification for the community, echoing the sustainable tourism goal of creating local livelihood opportunities (United nations, 2022). Graph 2 below showed that Sustain Candle program is beneficial (educational and enriching) for the participants.



Graph. 2 Responses Product Output and Economic Benefits

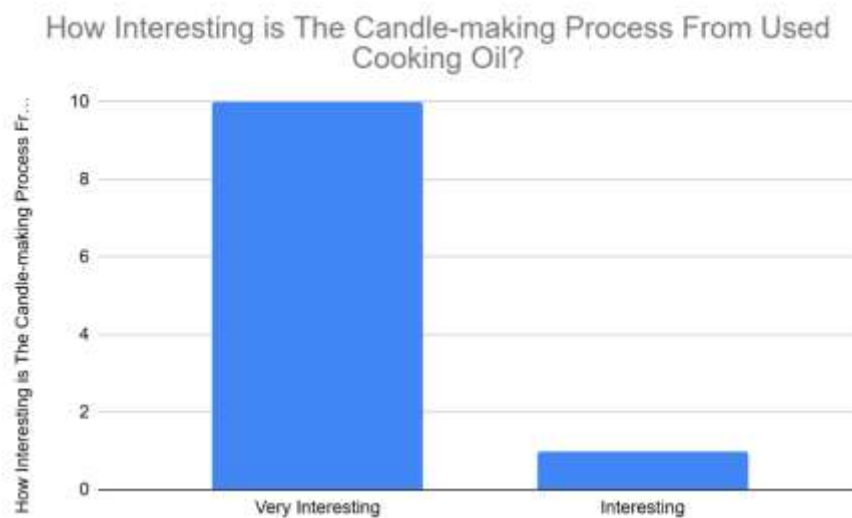
Source: Primary Data Processed, 2025

Tourist Reception and Satisfaction

The tourist surveys and feedback revealed a high level of interest and satisfaction with aromatic candles as a tourism product. Out of 90 tourist respondents (visitors who had spent time in Ngestirejo’s craft market or homestays), 67% had purchased at least one candle as a souvenir, while an additional 20% did not purchase one but participated in a candle-making demonstration or expressed positive interest. The remaining 13% cited reasons not hearing about the product in time. When asked about their motivations, the majority of buyers (88%) indicated they were attracted by the product’s concept of recycling waste (“It’s meaningful to take home something made from recycling, rather than a generic souvenir,” one tourist said). Tourists rated their satisfaction with the candle product experience at an average of 4.6 out of 5. In particular, they gave high marks to “uniqueness” and “environmental friendliness” as attributes of the souvenir. Many visitors also appreciated the story behind the product; 75% of respondents agreed that knowing the candles were made from used oil by the villagers enhanced their travel experience, giving them insight into local life and sustainability efforts. Moreover, some tourists participated in a short hand- on activity where they could pour their own candle or see the process; this experience was cited as a highlight by several, aligning with trends in experiential tourism. The positive responses from tourists regarding this souvenir product indicate that destination social responsibility (DSR) has a direct correlation with tourist consumption value. As explained by Su et al. (2020), tourists tend to demonstrate higher loyalty toward destinations that are capable of offering products with both functional and emotional-ecological value. In this regard, ‘Lilin Taman Agung’ serves as an effective

communication medium to demonstrate Ngestirejo Tourism Village’s commitment to green tourism.

The presence of the candles appears to have marginally increased tourist spending and engagement in the village: according to homestay records and guides’ observations, tourists who bought candles often stayed slightly longer in the village (to attend the demo or chat with artisans) and spent on other local goods as well. Overall, 90% of tourists surveyed said they would recommend Ngestirejo to others as a “sustainable tourism village” because of initiatives like this, indicating a reputational benefit for the destination. Graph 3 below explaining tourist reception of the used cooking oil is very interesting.



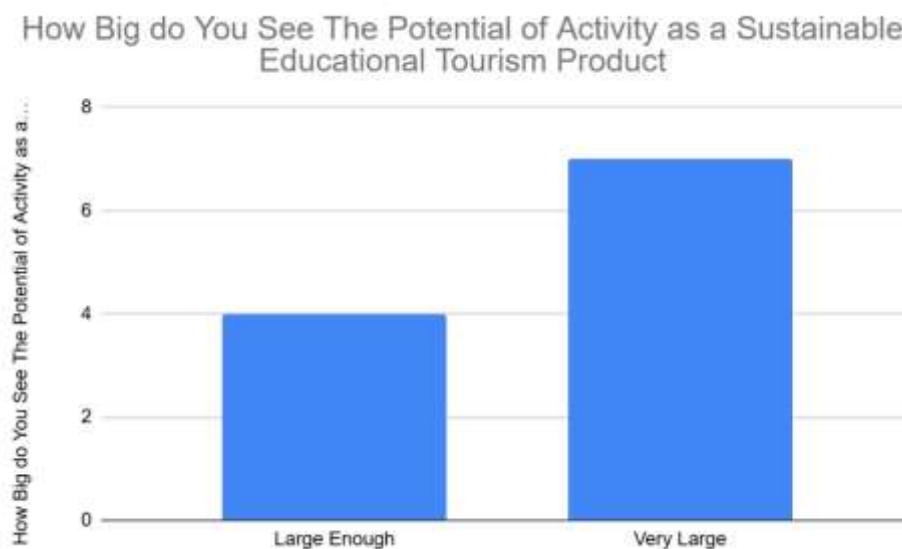
Graph 3. Responses Tourist Reception and Satisfaction

Source: Primary Data Processed, 2025

Social and Community Outcomes

Qualitative results from interviews and focus groups highlighted significant social impacts of the initiative. Community empowerment and pride emerged as strong themes. Local women involved in production reported increased confidence and skill development – for instance, they learned not only candle-making but also basic marketing (some learned to promote the product via social media as part of the project’s capacity building). One participant, a 34-year-old housewife, shared: “I never imagined I could be part of something sold to tourists. Now when I see visitors enjoy the candle I made, I feel proud and motivated.” The initiative also strengthened social cohesion: the candle project team had members from different hamlets of the village working together, which respondents said improved inter-neighborhood communication and collective problem-solving. When faced with challenges (like perfecting the scent or packaging), the group collaborated and even involved the village youth organization for creative ideas, fostering a spirit of “gotong royong” (community cooperation). Another notable outcome was increased environmental awareness and behavior change in the community. Interviewees consistently mentioned that before, they paid little attention to waste oil, but now even those not in the core group save their oil because they know it has value. Additionally, the project sparked discussions about other sustainability ideas (some villagers are now interested in learning about making soap from oil or recycling

plastic waste), indicating a broader mindset change. In terms of education, local school teachers invited the candle makers to demonstrate the process to students, effectively integrating environmental education into the local curriculum in a practical way. Policy and network effects were also observed: the district Tourism Office took note of Ngestirejo’s success and indicated plans to include the candle-making as part of official tour packages, and possibly replicate similar training in other villages. The village received a small grant from a regional sustainable tourism competition, which will be used to build a proper workshop space for producing the candles with better equipment. These social outcomes demonstrate that the benefits of the initiative transcended financial gains, contributing to community development and knowledge – crucial facets of sustainable tourism development. Graph 4 explaining the great potential of this sustainability action.



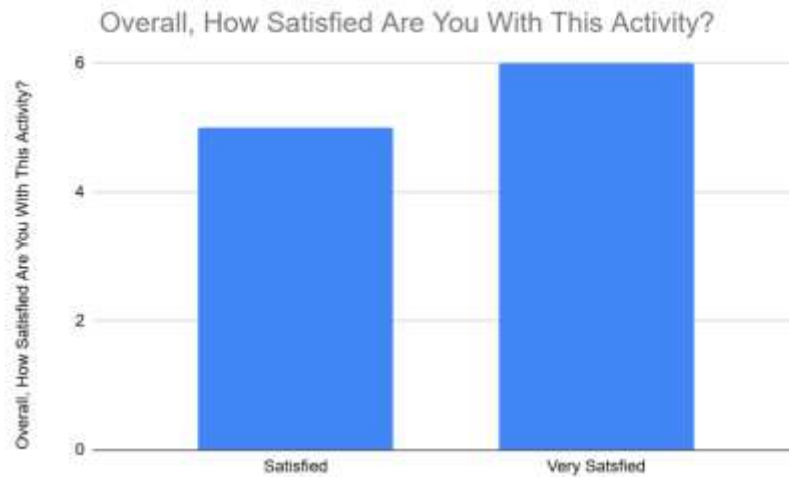
Graph 4. Responses Social and Community Outcome

Source: Primary Data Processed, 2025

Challenges and Lessons Learned

Graph 5 below showing the great number of people very satisfied with the program. However, the results were not without challenges, and these provide valuable lessons for future implementation. A few challenges that emerged included: (a) Technical issues – early in the project, the candles sometimes had a residual faint smell of cooking oil, which was a concern. Through experimentation, the team learned to add more natural fragrance and use dried citrus peels (as an absorbent) to eliminate the odor, improving product quality. (b) Resource limitations – at times, the supply of used oil actually exceeded the group’s candle production capacity (since only a limited number of molds and work hours were available), leading to stored oil that had to be carefully kept to avoid rancidity. This highlighted a need for scaling up capacity or finding additional uses for excess oil (some was eventually turned into laundry soap as a side experiment). (c) Market and distribution – while tourist sales on-site were strong, the group struggled with expanding sales beyond immediate visitors. In summary, the hypothetical results indicate that repurposing used cooking oil into aromatic candles in Ngestirejo Village would likely yield positive outcomes across environmental, economic, and social domains. The project reduces waste and pollution, generates income

and diversifies livelihoods, enhances tourist experiences, and strengthens community capacity – essentially serving as a microcosm of sustainable development in a tourism context. These results set the stage for a discussion on their broader implications and alignment with theory and policy.



Graph 5. Responses Challenges and Lessons Learned

Source: Primary Data Processed, 2025

Analysis of the six-month pilot implementation reveals that this project’s initiative successfully processed 120 liters of used cooking oil. Quantitative survey data from the tourists indicated a high acceptance rate, with 67% of respondents expressing a preference for eco-friendly souvenirs over traditional mass-produced items. Furthermore, qualitative insights from local artisans suggest that the primary barrier to scale is not technical capability, but rather the logistical consistency of raw material collection.

The findings provide strong evidence that repurposing used cooking oil into aromatic “Sustain Candles” can serve as a viable strategy for sustainable rural tourism development. Interpreted through theoretical frameworks, the initiative demonstrates how circular economy principles, community-based tourism (CBT), and experiential learning intersect to advance environmental, economic, and social goals.

The project illustrates balanced achievements across the three pillars of sustainability: environmental gains through pollution reduction and resource efficiency; economic benefits via job creation and local enterprise; and social outcomes in the form of empowerment, cultural continuity, and strengthened community cohesion. These integrated results exemplify the “triple bottom line” approach and confirm the potential of grassroots initiatives to achieve synergies that are often elusive in tourism development.

The initiative is also a notable case of Community Based Tourism as villagers-maintained ownership and benefits. Women’s groups gained new skills and income, fostering gender equity and inclusion. Recognition from local authorities further illustrates how grassroots innovation can attract institutional support, creating a reinforcing cycle of empowerment and visibility.

The transformation of local community's role in Ngestirejo Village demonstrates that tourism sustainability heavily depends on the dynamic relationship between the community

and its environment. According to Arias-Hidalgo and Sotomayor (2023), active involvement in sustainability practices, such as repurposing waste into souvenirs, provides not only financial benefits but also strengthens the social resilience of the village. The success of the 'Lilin Taman Agung' initiative reflects a sustainable destination management model, where environmental values are internalized to become a unique local identity (Pencarelli, 2020).

In addition, Tourists valued the candles not only as souvenirs but also as symbols of environmental stewardship and cultural authenticity. Such experiences align with ecotourism literature, where visitor involvement in local sustainability practices enhances satisfaction and deepens awareness (Andreson, 2025). The high willingness to recommend Ngestirejo highlights the branding potential of integrating sustainability into tourism experiences.

Challenges Identified

Despite strong enthusiasm, respondents acknowledged several challenges. First, technical issues such as eliminating residual odors from used oil and ensuring consistent product quality were highlighted. Second, resource and production constraints limit the capacity to meet growing demand, particularly during peak tourist seasons. Third, marketing and distribution beyond the village remain underdeveloped, with many respondents stressing the need for stronger branding, packaging, and online sales channels. These challenges underscore the necessity of training, infrastructure support, and external partnerships to ensure scalability and long-term viability.

Finally, villagers articulated aspirations to expand the initiative beyond candle-making. Some expressed interest in exploring other upcycling innovations, such as soap or biofuel, suggesting that the candle project has sparked wider awareness and creativity around waste management. Others proposed integrating the initiative into formal tourism packages, school curricula, and inter-village Networks to ensure sustainability and replication.

CONCLUSION

This study demonstrates that the transformation of used cooking oil into aromatic candles represents a strategic approach to promoting sustainable tourism through circular economy practices in Ngestirejo Village. The initiative not only delivers environmental benefits by reducing waste, but also generates economic value, strengthens community empowerment, and enhances tourism attractiveness. Despite facing technical challenges and limited production capacity, the program shows strong potential for scalability and replication. Overall, the Waste-to-Value model confirms that the integration of local innovation, community participation, and sustainability principles can serve as an effective solution for fostering inclusive and sustainable rural tourism development. Based on these findings, several recommendations can be proposed. First, local stakeholders should strengthen technical training and quality control to ensure product standardization and improve competitiveness in wider markets. Second, there is a need to enhance production capacity through better infrastructure, equipment support, and more systematic raw material management. Third, marketing strategies should be expanded by utilizing digital platforms, branding improvements, and collaboration with tourism agencies to reach a broader consumer base. Fourth, local government and related institutions are encouraged to provide policy support, funding, and integration of this initiative into official tourism programs to ensure long-term sustainability. Finally, future research is recommended to explore the development of other waste-based products and to examine the long-term socio-

economic and environmental impacts of similar circular economy initiatives in different rural tourism contexts.

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