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Integrating Appropriate Technology and Digital Branding to Enhance Value Addition in Coffee Agroforestry

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Abstract

This community engagement program aimed to strengthen the capacity of Wonosoborejo Forest Farmer Group members through an integrated intervention combining appropriate technology for coffee agroforestry, leaf-litter composting, and initial digital branding through a group website. Fifteen active members participated in a one-day program on 30 October 2025 consisting of interactive presentations, demonstrations, discussion, and hands-on composting practice. Program evaluation used five dichotomous pre-test and post-test items covering compost knowledge and an eight-item satisfaction questionnaire scored on a five-point scale. The average number of participants answering "yes" increased from 3.4 of 15 participants (22.7%) before the activity to 14.6 (97.3%) after the activity. Participant satisfaction was very high, with an overall mean of 4.79 out of 5. The program also produced a website as an initial information and digital branding channel for the group. The available evidence therefore supports a marked short-term improvement in compost-related knowledge and strong participant acceptance of the training. However, because the evaluation did not measure website traffic, sales, income, long-term technology adoption, soil quality, or coffee productivity, broader market and economic impacts should be treated as prospective outcomes requiring follow-up assessment.

Keywords: *coffee agroforestry; appropriate technology; composting; digital branding; community empowerment*

INTRODUCTION

Malang Regency has substantial forestry and plantation resources and provides a relevant setting for community enterprises based on agroforestry. The source manuscript states that the Wonosoborejo Forest Farmer Group manages approximately 230 hectares of land and has around 150 active members. This resource base offers opportunities for coffee-based livelihoods, but the potential has not been fully accompanied by adequate use of cultivation technology, organic residue management, post-harvest improvement, and market communication. Productivity, input efficiency, environmental management, product quality, and market access therefore constitute interconnected challenges rather than isolated technical issues.

At the cultivation level, the source manuscript identifies continued reliance on conventional practices and limited application of good agricultural practices as important constraints. Excessive dependence on chemical fertilizers can increase production costs and place additional pressure on soil and water resources (Hema & Ilavarasan, 2016). At the same time, locally available biomass, including leaf litter, creates an opportunity to recycle organic material within the production system. Sustainable agroforestry increasingly emphasizes the need to combine productive objectives with soil stewardship, ecological functions, and efficient use of locally available resources (Lecegui et al., 2024; Parodi et al., 2022).

Coffee quality and value addition are also influenced by post-harvest handling. Studies on coffee processing show that post-harvest operations affect physicochemical and sensory quality, while suitable processing technologies can help local growers improve consistency and product competitiveness (Clemente et al., 2015; Buclatin, 2020). Although the present program did not directly test coffee-processing technologies, these findings are relevant to the broader development pathway of the group: technical improvement must eventually connect cultivation, soil management, post-harvest quality, and market positioning.

A second challenge concerns value addition and market access. Community-based products require a recognizable identity and communication channels that can reach potential consumers beyond immediate local networks. A website can serve as a central digital space for presenting the group profile, activities, products, contact information, production stories, and other promotional materials. The literature cited in the source manuscript positions digital marketing and websites as tools that can support brand awareness and promotion (Manera & Muizu, 2025; Setiawati & Ismail, 2025). Nevertheless, the existence of a website alone does not demonstrate increased sales, stronger brand awareness, or higher income; such outcomes require direct indicators such as traffic, engagement, inquiries, conversion, transactions, or consumer surveys.

The practical gap addressed by this program lies in the limited integration between technical capacity building in organic-resource management and the strengthening of a digital communication channel for the same forest farmer group. The intervention therefore combined training on composting leaf litter, an introduction to appropriate technology within the coffee agroforestry context, and the development of a website

as an initial information and branding platform. The program was designed as a capacity-building intervention that links production-side knowledge with an early form of market communication rather than as an experimental trial of a single technology.

Appropriate technology is particularly relevant in community empowerment because its value does not depend primarily on sophistication. A technology is appropriate when it fits local resources, user capabilities, maintenance requirements, affordability, and the practical problems faced by the community. Leaf-litter composting is compatible with this principle because the raw material is available around the production area and can be processed with relatively simple equipment. The practice also encourages a shift in perception from organic residue as waste toward biomass that can be returned to the production cycle. This orientation is consistent with circularity approaches in sustainable agroforestry (Parodi et al., 2022), although the current activity did not measure soil properties, nutrient availability, or crop yield.

It is important to distinguish capacity improvement from production performance. Capacity can be reflected in increased knowledge, initial practical skills, confidence, or readiness to attempt a new practice. Production performance, by contrast, requires more direct indicators such as the quantity and quality of compost produced, reduction in purchased inputs, changes in soil properties, coffee yield, bean quality, or farm income. The source manuscript occasionally moved rapidly from training outcomes to broader economic claims. To maintain analytical accuracy, the present article treats the measured results as short-term capacity outcomes and reserves productivity and economic effects for future evaluation.

The same distinction is necessary for digital branding. Digital branding is broader than website development. It involves consistent messages, visual identity, useful content, regular updates, connection with other channels, responsiveness to potential consumers, and the ability to translate attention into meaningful interaction. In this program, the website is therefore interpreted as initial infrastructure. It provides a foundation that may support branding and future marketing activities, but it does not by itself prove market expansion. This interpretation remains consistent with studies emphasizing digital media for brand awareness and website-based promotion while avoiding unsupported causal claims (Manera & Muizu, 2025; Setiawati & Ismail, 2025).

From a community-service design perspective, combining technical training and a digital channel provides an upstream-to-downstream orientation. The technical component seeks to improve how members use resources available around their production area, while the digital component seeks to improve how the group presents its identity and potential products to the public. Such integration is relevant because natural-resource-based community enterprises often face multiple constraints simultaneously. Technical capacity may improve while value addition remains limited if market communication is weak; conversely, digital promotion is unlikely to be sustainable if product quality and production practices are not managed consistently.

The practical novelty of the program lies not in inventing a new composting technology or a new digital platform but in combining leaf-litter composting capacity building with the establishment of a digital branding channel within the same forest farmer group. This integrated intervention responds to the group's immediate technical and communication needs. Its contribution is therefore best understood as a community empowerment model with linked technical and digital components. Because the activity lasted one day and evaluation was conducted immediately after training, conclusions must remain focused on short-term responses rather than long-term behavior, technology adoption, market performance, or economic impact.

Based on this context, the program aimed to improve the initial knowledge and practical understanding of Wonosoborejo Forest Farmer Group members regarding leaf-litter composting, introduce appropriate technology in the context of coffee agroforestry, and provide a group website to support information dissemination and initial digital branding. Short-term success was assessed through changes in pre-test and post-test responses related to compost knowledge and through participant satisfaction. Market expansion, income change, long-term adoption, and productivity were not treated as outcomes already demonstrated by the available evaluation.

METHOD

The community engagement activity was conducted with the Wonosoborejo Forest Farmer Group in Malang Regency, East Java, on 30 October 2025. The source manuscript gives inconsistent subdistrict and village information across sections; therefore, this edited version reports the location at the regency level until the exact administrative location is confirmed by the authors. Participants were 15 active members of the group.

The program consisted of three main components. The first was an interactive session introducing appropriate technology for coffee agroforestry. The second was an introduction to digital branding and website-based marketing through the development of a group website. The third was hands-on training in producing compost from leaf litter. Equipment reported in the source manuscript included a leaf chopper, composting drums, and EM4 microbial decomposer purchased from an agricultural supply store.

Implementation began with permission and coordination with the forest farmer group, distribution of invitations, participant registration, attendance recording, and a pre-test. The learning session combined presentations with discussion and question-and-answer activities. After the conceptual explanation, participants observed a demonstration and took part directly in the composting practice. At the end of the activity, participants completed a post-test and a satisfaction questionnaire.

The available pre-test and post-test instrument covered five aspects: the definition of compost, the benefits of compost, how to make compost, materials used in composting, and practical compost-making. Responses were recorded as the number of participants answering "yes" for each aspect. Because the source manuscript did not report inferential statistical procedures and individual paired data were not available,

analysis was limited to descriptive counts, percentages, and before-and-after differences. The term "statistically significant" is therefore intentionally avoided.

Participant satisfaction was assessed across eight aspects using a scale from 1 to 5: ease of understanding the material, clarity of delivery, overall implementation of the activity, adequacy of facilities and tools, adequacy of time, perceived improvement in knowledge, interest in making and using compost, and perceived benefit for the community. A score of 1 represented the lowest level of satisfaction or agreement and a score of 5 the highest. The analysis used the mean score for each aspect and the overall mean.

Operationally, the program can be described using an input-process-output sequence. Inputs included facilitators, the community-service team, participants, leaf-processing equipment, composting drums, microbial decomposer, training materials, and website development. The process consisted of presentation, discussion, demonstration, hands-on practice, and evaluation. Outputs that can be verified from the source material include completion of the training, pre-test and post-test results, participant satisfaction data, and the availability of the group website. The closest short-term outcome measured by the instrument was improved recognition of compost-related concepts and procedures.

The dichotomous "yes/no" instrument was practical for a short community training activity but had limited sensitivity. A participant answering "yes" may not possess the same depth of understanding as another participant. For example, knowing the definition of compost differs from being able to select appropriate materials, control moisture, maintain aeration, or determine compost maturity. Accordingly, the results are interpreted as indicators of initial knowledge or recognition rather than a comprehensive measure of technical competence. Future activities could employ multiple items for each domain, a practical skills rubric, and direct assessment of compost quality.

Percentages were calculated by dividing the number of "yes" responses for each aspect by the total number of participants (n = 15) and multiplying by 100. The average number of positive responses was calculated across the five pre-test aspects and five post-test aspects. Satisfaction was summarized using the reported mean scores across eight aspects. Because individual-level data were unavailable, the analysis did not calculate paired differences, standard deviations, confidence intervals, or significance tests. This analytical choice prevents the interpretation from extending beyond the information contained in the source manuscript.

The one-group before-and-after design is useful primarily for process evaluation and immediate short-term outcomes. Changes observed immediately after the activity may be associated with the content and practice participants have just received, but the design cannot exclude other explanations or assess retention over time. The post-test may also reflect immediate recall. Follow-up after several weeks or months would be required to determine whether knowledge is retained and whether participants independently apply the composting procedures in their routine group activities.

RESULTS AND DISCUSSION

Training Implementation and Changes in Compost-Related Knowledge

The activity was delivered as an intensive one-day training program combining explanation, discussion, demonstration, and practice. Lecturers, the community-service team, students, and forest farmer group members participated in a field-based learning setting. Leaf litter was used as the primary composting material because it is available in the local environment and can be treated as a production resource rather than simply discarded biomass. This approach is consistent with broader efforts to recycle local organic materials and support more circular agroforestry systems (Parodi et al., 2022).

Pre-test and post-test data showed a clear descriptive change across all five aspects. Before the activity, the number of participants answering "yes" ranged from only 1 to 7 out of 15. After the activity, the range increased to 14–15 participants. The mean number of positive responses increased from 3.4 participants to 14.6 participants. Expressed as a proportion of the total sample, the mean rose from approximately 22.7% to 97.3%. Detailed results are presented in Table 1 and visualized in Figure 1.

Table 1. Changes in Participants' Pre-test and Post-test Responses

Aspect	Pre-test (n)	Pre-test (%)	Post-test (n)	Post-test (%)
Definition of compost	7	46.7	15	100.0
Benefits of compost	4	26.7	14	93.3
How to make compost	1	6.7	15	100.0
Composting materials	3	20.0	14	93.3
Composting practice	2	13.3	15	100.0
Mean	**3.4**	**22.7**	**14.6**	**97.3**

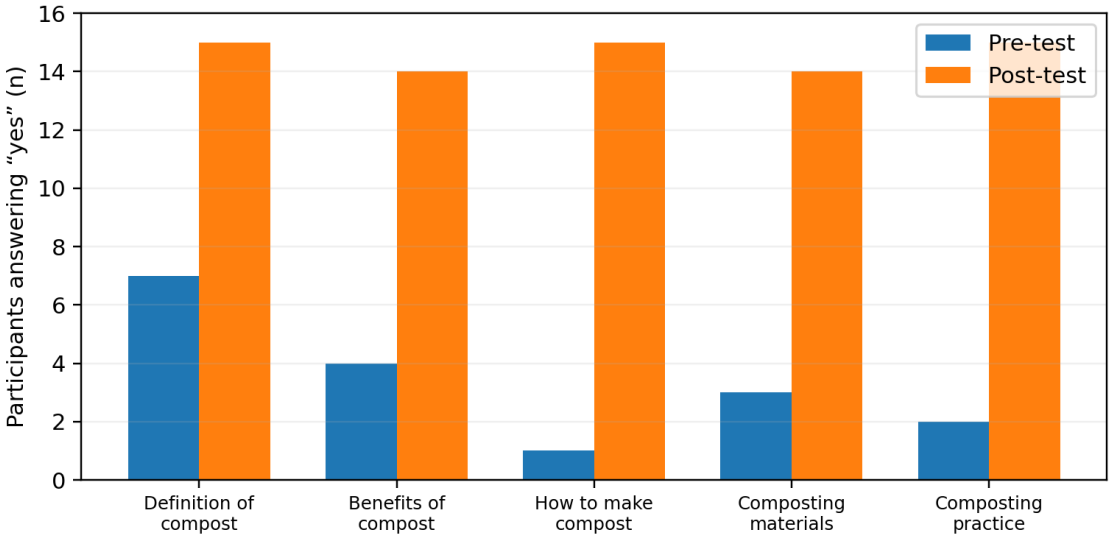

Figure 1. Pre-test and post-test responses of training participants

The largest change occurred in knowledge of how to make compost, increasing from 1 participant before training to all 15 participants after training. Practical compost-making increased from 2 to 15 participants. These results are consistent with the structure of the activity, which combined explanation with direct demonstration and practice. Procedural learning is often strengthened when participants can observe a sequence, ask questions, and immediately perform the task rather than receiving information only in lecture form. Nevertheless, because the instrument used "yes/no" responses and did not include paired individual scores or inferential analysis, the findings should be read as a strong descriptive short-term change rather than proof of statistical significance or causal effect.

Knowledge of the definition and benefits of compost also improved, indicating that the activity reinforced both conceptual and procedural components. Pre-test and post-test evaluation can be valuable in training because it helps facilitators observe immediate learning change and identify material that still requires reinforcement (Keane et al., 2025). In the present program, the post-test provides evidence that almost all participants recognized the concepts addressed during the activity. It does not, however, show whether the knowledge was retained after the training day or whether participants could independently troubleshoot composting problems in real field conditions.

From an empowerment perspective, improved compost-related knowledge is relevant because it concerns a material that is readily available around the group's production environment. Leaf litter that is normally underused can potentially be processed into organic material for agricultural use. Such a practice may reduce waste and, if adopted consistently and produced at sufficient quality and volume, could contribute to more efficient use of external inputs. These potential benefits should be evaluated directly in future work through indicators such as compost volume, maturity, nutrient content, frequency of production, area of application, and changes in purchased fertilizer use.

The baseline results also demonstrate why the training was needed. Only one participant reported understanding how compost is made, and only two reported understanding practical compost-making before the activity. Even for the most familiar aspect—the definition of compost—fewer than half of the participants answered positively. This pattern suggests that the initial knowledge gap was not limited to technical details but included basic concepts. In such circumstances, a training design that moves from definition and benefits to materials, procedures, and direct practice is appropriate because it builds learning progressively.

At the same time, the high post-test values must not be interpreted as full mastery. Fourteen or fifteen positive responses indicate that most participants perceived or demonstrated immediate understanding in the format of the instrument. Competence in compost production is more complex. It may involve identifying suitable carbon- and nitrogen-rich materials, controlling moisture and aeration, recognizing temperature changes, managing decomposition time, and evaluating maturity. Future evaluation would be stronger if it included a practical rubric or assessment of the compost produced after a complete decomposition cycle.

Environmentally, the use of leaf litter supports the principle of returning organic biomass to productive use. The source manuscript relates this activity to reduced dependence on chemical fertilizers. That pathway is plausible, but the present program did not measure fertilizer substitution, soil quality, or crop response. Consequently, the evidence supports learning about composting and initial practical exposure, while environmental and agronomic benefits remain expected outcomes that require monitoring. This distinction makes the community-service report more useful because it shows both what was achieved and what still needs to be verified.

Value addition in this context should therefore be understood as a staged process. The first stage is improved knowledge and practical readiness. The second is consistent production and use of compost. The third is potential improvement in production efficiency or environmental management, and a later stage may involve product quality, market communication, and income. The current evaluation directly documents the first stage. Subsequent stages should be assessed rather than assumed.

Participant Satisfaction with the Training

After the training, participants evaluated eight aspects of implementation. All mean scores were above 4.5 on a five-point scale. The highest rating was the perceived benefit of the activity for the community (5.00), followed by perceived knowledge improvement and interest in making and using compost (both 4.87). The lowest score, although still very high, concerned the adequacy of facilities and tools (4.60). The overall mean was 4.79, indicating very strong participant acceptance of the program. The results are summarized in Table 2 and Figure 2.

Table 2. Mean Participant Satisfaction Scores

Assessment aspect	Mean score
Material was easy to understand	4.73
The facilitator explained the material clearly	4.67
The activity was implemented well	4.80
Facilities and tools were adequate	4.60
The allocated time was sufficient	4.80
The activity increased knowledge	4.87
Interest in making and using compost	4.87
The activity was beneficial for the community	5.00
Overall mean	**4.79**

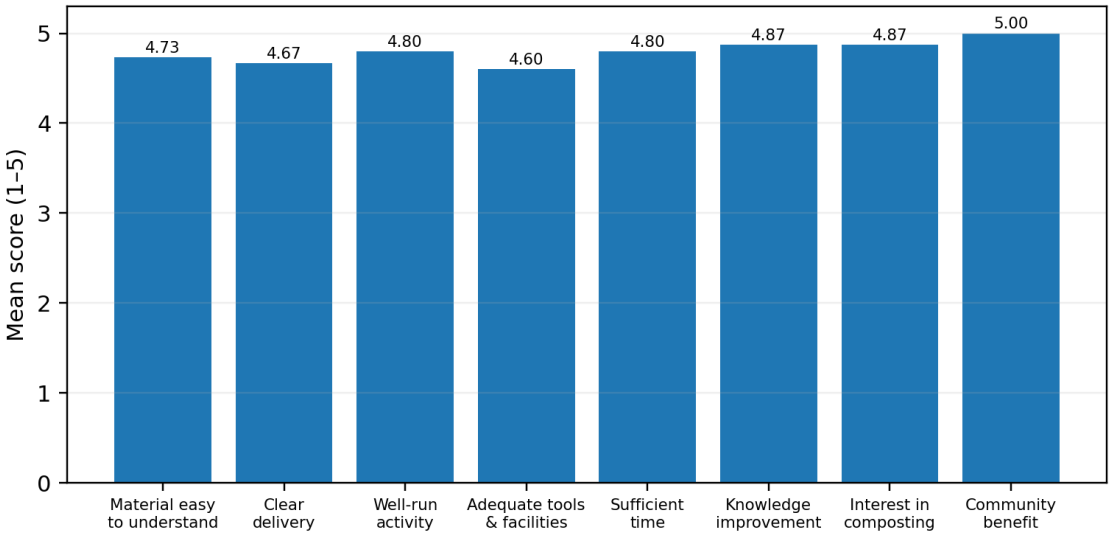

Figure 2. Mean participant satisfaction with the training

The high satisfaction scores indicate that participants considered the material relevant, the activity well organized, and the training beneficial. Satisfaction is important in community learning because positive experiences can strengthen willingness to participate in follow-up activities and apply newly introduced practices. Julika et al. (2025), although working in a different educational context, similarly emphasize the relationship between learning design, motivation, and participant engagement. In the present activity, the combination of explanation and practice likely contributed to the favorable response.

Differences between aspects also provide information for program improvement. The facilities-and-tools score of 4.60 was the lowest among the eight indicators. This

does not represent dissatisfaction, but it can be treated as a signal to review the number of tools, participant-to-equipment ratio, comfort of the practice area, or availability of materials. Small improvements in these operational elements may make future sessions more efficient, particularly if the number of participants is increased.

The scores of 4.87 for perceived knowledge improvement and interest in making and using compost are especially relevant because they align with the learning objective. They indicate that participants not only liked the activity but also perceived it as useful and applicable. The perfect mean score for community benefit (5.00) further suggests that participants saw the program as connected to their collective needs. Still, satisfaction should be interpreted as a perception measure; it is not a substitute for direct evidence of behavior change or production outcomes.

High satisfaction can become social capital for follow-up assistance. Participants who consider the material useful and the method accessible may be more open to continued mentoring. Future programs could use this acceptance to move from one-day exposure toward repeated practice, simple production records, peer learning within the group, and periodic review of compost quality. In this way, satisfaction becomes an entry point for sustained engagement rather than an endpoint of evaluation.

Website as an Initial Digital Branding and Marketing Channel

In addition to technical training, the program produced the website "kthwonosoborejo.id" as an initial digital channel for group information and branding. A website can provide a stable public location for group identity, activity documentation, product descriptions, contact information, and future promotional content. Compared with communication that depends entirely on personal networks, a website can help organize information and make it accessible to a wider audience at any time. This role is consistent with the promotional and branding functions described by Manera and Muizu (2025) and Setiawati and Ismail (2025).

The source manuscript originally stated that the website expanded market reach and strengthened brand identity. The available evaluation, however, does not include before-and-after website traffic, visitor origin, search visibility, social-media referrals, consumer inquiries, transactions, sales volume, or brand-recognition measures. It is therefore methodologically more accurate to classify the website as a program output and enabling infrastructure. The potential for market expansion is reasonable, but the effect remains to be demonstrated through subsequent data.

The website component is nevertheless strategically relevant because it links technical empowerment with communication. Improvement in production practices is more likely to generate value when the group can present its activities and products credibly, while digital promotion is more sustainable when supported by consistent production and product quality. The program therefore offers an integrated direction in which technical and digital capacity can reinforce one another. What is needed next is an evaluation design that captures both sides of this relationship.

Website development will have greater value if accompanied by content governance. The group needs to determine who is responsible for account access, content updates, product photography, written descriptions, contact responses, and data security. Without clear responsibilities, a website can quickly become a static archive. With regular updates, it can document the group's activities, show production processes, communicate product stories, and provide reliable contact information. These functions can contribute to credibility even before direct sales functions are introduced.

Simple digital indicators could be incorporated into future monitoring. At the reach level, the group could record visitor numbers, frequently viewed pages, and geographic origin. At the engagement level, it could monitor contact-button clicks, incoming messages, or requests for product information. At the conversion level, records could identify inquiries that become purchases and the value of transactions originating from the digital channel. When collected over time, such data would allow claims of market expansion to be tested objectively rather than inferred from website availability.

Digital literacy is another important sustainability factor. It includes more than the ability to open a website; members may need skills in content management, account security, product photography, short-form copywriting, basic analytics, and communication with users. The source manuscript referred to improved digital literacy, but no specific instrument measured this outcome. A future program could therefore add a digital pre-test and post-test based on practical tasks—for example, uploading content, editing product information, responding to messages, or reading simple traffic analytics.

The program was also linked in the source manuscript to Sustainable Development Goals 1 and 8, concerning poverty reduction and decent work and economic growth. The connection is conceptually relevant if technical and marketing capacity eventually contributes to productivity or income. However, the activity did not measure income change, job creation, or poverty indicators. It is therefore more appropriate to describe the program as aligned with these development directions rather than as having already produced measurable SDG-level impact.

An important implication of the combined intervention is that technical and digital activities should eventually be evaluated within the same value-creation pathway. Composting knowledge may support more efficient resource management, but its contribution to value addition becomes clearer only when later indicators show whether compost is produced consistently, used in coffee plots, and associated with changes in input use or crop performance. Likewise, a website may improve information availability, but its contribution to value addition becomes clearer when it generates measurable audience reach, product inquiries, or sales. Connecting these indicators would allow future community-service cycles to explain how technical learning and digital communication interact rather than reporting them as unrelated outputs.

This integrated perspective can also help the group prioritize realistic investments. If follow-up shows strong compost adoption but weak digital engagement, assistance can focus on content creation, product presentation, and market communication. If website interest grows while product supply remains inconsistent, technical and organizational support should receive greater emphasis. In other words, monitoring is not only an academic requirement; it can guide practical decisions about where limited group resources and mentoring time should be directed. A small set of regularly recorded indicators could therefore become a management tool for the farmer group as well as evidence for evaluating the community engagement program.

Limitations and Development Implications

The first limitation is the small number of participants and the one-day evaluation period. Fifteen participants are appropriate for a focused group training activity but do not support statistical generalization to all members of the forest farmer group or to other communities. The knowledge instrument also consisted of only five dichotomous aspects. Individual-level paired data were unavailable, and no comparison group was used. These limitations do not eliminate the usefulness of the evaluation, but they clearly define the level of inference that can be made.

The second limitation is the absence of follow-up. The program did not report how many participants produced compost again after training, whether compost was applied to coffee plots, what quantity was produced, or what difficulties occurred without direct facilitation. Follow-up after one, three, or six months could use the same knowledge domains together with direct observation of practice. A longitudinal approach would clarify whether knowledge is retained and whether initial enthusiasm becomes routine adoption.

The third limitation concerns the digital component. No baseline digital-capacity measure, website analytics, sales data, or brand-awareness indicator was available. Consequently, website development must be treated as an output rather than an outcome. Future evaluation should establish realistic digital targets, such as regular content updates, number of products displayed, proportion of members able to manage the site, growth in visits, incoming product inquiries, or transactions generated through digital contact points.

Overall, the program could be developed into staged mentoring. The first stage would focus on knowledge and basic practice; the second on repeated compost production, record keeping, and practical problem solving; and the third on content management and market interaction through digital channels. Each stage should have its own indicators. This approach would move evaluation beyond satisfaction toward behavior and performance while keeping community empowerment goals realistic and measurable.

For sustainability, training outcomes can also be incorporated into the group's internal working mechanisms. Knowledge should not remain only as individual experience but can be documented in simple procedures, material records, production schedules, and responsibility assignments. The same principle applies to website

management: account access, content updates, product documentation, and responses to potential consumers should be assigned clearly. Such organizational routines can reduce the risk that progress is lost when individual members are unavailable or group management changes.

A more mature community-service evaluation can combine quantitative and qualitative evidence. Quantitative indicators could include knowledge scores, compost volume, input costs, website visits, inquiries, and transactions. Qualitative evidence could come from interviews about ease of application, barriers, changes in routine, perceived benefits, and group decision-making. Combining these forms of evidence would explain not only whether change occurred but also how and why it occurred. For a community engagement article, this would strengthen the connection between the initial problem, intervention, outcome, and longer-term impact.

CONCLUSION

The community engagement program with the Wonosoborejo Forest Farmer Group produced a strong descriptive short-term improvement in participants' compost-related knowledge. Across five evaluated aspects, the mean number of participants answering "yes" increased from 3.4 of 15 participants before training to 14.6 after training, while overall participant satisfaction reached 4.79 out of 5. The program also produced a website as an initial channel for group information, digital branding, and prospective product marketing. The evidence directly supports improved immediate compost-related knowledge and very high participant acceptance. Effects on coffee productivity, fertilizer use, soil quality, market expansion, sales, income, digital literacy, and long-term technology adoption were not measured and therefore require follow-up evaluation. Continued mentoring, repeated practical assessment, and systematic monitoring of technical and digital indicators are needed to determine whether the initial capacity gains develop into sustained operational, environmental, and economic benefits.

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