

STRENGTHENING SDG IMPLEMENTATION IN DAUP VILLAGE THROUGH WASTE MANAGEMENT, CONSERVATION, AND MSME DIGITALIZATION

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Abstract

Daup Village, Kintamani District, Bangli Regency, Bali, is a highland area with considerable potential in agriculture and micro, small, and medium enterprises (MSMEs), yet it continues to face challenges related to waste management, environmental conservation, and the use of digital technology. This community service program aimed to strengthen community capacity in environmental management while improving local economic competitiveness through an integrated approach aligned with the Sustainable Development Goals (SDGs). The program used a participatory approach involving observation, outreach, training, hands-on practice, mentoring, monitoring, and evaluation. Activities included waste sorting and strengthening the Waste Bank, processing organic waste into compost, planting productive vegetation to support soil and water conservation, and digitalizing MSMEs by optimizing business-location information on digital maps and introducing cashless transactions through QRIS. The results indicate improved community knowledge and skills in sorting and managing waste, greater utilization of organic waste as compost, increased participation in conservation activities, and stronger understanding among MSME operators of digital technologies and cashless payments. The integrated program demonstrates that environmental management can be advanced alongside community economic strengthening through the effective use of local resources and technology. The activities contribute to SDGs 8, 12, 13, and 15 and provide a foundation for developing a community-empowerment model oriented toward environmental sustainability and improved economic competitiveness in Daup Village.

Keywords: Waste Management, Environmental Conservation, MSME Digitalization, Daup Village, SDGs

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1. INTRODUCTION

Daup Village is geographically located in the highland area of Kintamani District, Bangli Regency, Bali Province. The village lies at an elevation of approximately 1,314 meters above sea level and covers an area of about 269,000 m², or 26.9 hectares. According to the Daup Village profile, approximately 253,250 m², or about 94.1% of the village area, consists of dryland agriculture, plantations, and cultivated fields, while the remainder is used for settlements, livestock activities, public facilities, and other purposes (BPS Kab Bangli, 2025). This land-use structure indicates that both the ecological and economic foundations of Daup Village are strongly dependent on the agricultural sector. Community empowerment data for Daup Village also record approximately 662 residents in 182 households, with around 75% of the population working as farmers, livestock farmers, farm laborers, and construction workers (BPS Kab Bangli, 2025). These conditions underscore the direct relationship between the sustainability of land quality and agricultural productivity and the sustainability of local livelihoods. In addition to oranges, Daup Village has potential commodities such as coffee, bananas, pineapples, jackfruit, and various other crops that can be developed as a basis for the local economy and ecotourism in the Kintamani area.

Nevertheless, the considerable potential of the agricultural sector and the increasing economic activities of the community are accompanied by a range of environmental issues that require attention. The intensification of agricultural activities generates organic waste in the form of crop residues, leaves, branches, unsalable fruit, and other organic materials. At the same time, household consumption activities generate increasingly diverse forms of both inorganic and organic waste. The magnitude of this challenge can be illustrated by the broader context of Bangli Regency: based on SIPS data cited by the Bangli Regency Government, waste generation in 2024 reached 113.86 tons per day, or approximately 41,557 tons per year. At the Bali Province level, regional planning documents using DKLH data indicate that 60.3% of generated waste is organic. Although these figures are aggregate data rather

than measurements specific to Daup Village, they demonstrate that organic waste management represents a strategic intervention. In Daup Village, this urgency is particularly relevant because approximately 94.1% of the village consists of agricultural land, plantations, and cultivated fields that continuously generate organic biomass. Without an appropriate management system, household and agricultural waste may accumulate, while materials that retain value may lose opportunities for reuse or recovery (Hakiki, R., & Wibowo, A., 2023).

Organic waste management offers substantial development potential in Daup Village because of the community's predominantly agricultural characteristics. Organic waste that has traditionally been regarded as residual material can be processed into compost and returned to agricultural land as a source of soil organic matter. This approach can establish a more sustainable resource-management cycle by simultaneously reducing the volume of waste requiring disposal and providing useful agricultural inputs (Utama, I. M. S., & Dewi, R. K., 2024). Meanwhile, economically valuable inorganic waste can be directed through sorting and collection mechanisms operated by the Waste Bank. Waste management can therefore be positioned not only as an effort to address environmental problems, but also as a productive activity capable of generating additional economic benefits for the community (Purwendah et al., 2022).

In addition to waste-related issues, Daup Village's characteristics as a highland area make soil and water conservation particularly important. The sloping topography of the Kintamani area, if not accompanied by appropriate vegetation and soil management, can increase the risk of erosion, especially during periods of high rainfall. The loss of topsoil may reduce soil fertility and water-retention capacity while increasing the potential for sedimentation in drainage and water-flow systems, as noted by Nandini et al. (2022). This issue warrants particular attention because the Kintamani highlands have an ecological function as a water catchment area that contributes to maintaining regional hydrological balance.

Accordingly, environmental conservation efforts in Daup Village should not be limited to conventional tree-planting activities, but should also incorporate vegetative approaches that provide ecological benefits while creating economic value for the community. The development of agroforestry systems through the planting of productive crops and ground-cover vegetation represents one strategic alternative. Such vegetation can help strengthen soil structure, reduce the kinetic impact of rainfall, increase infiltration, and suppress erosion rates (Sari et al., 2023). At the same time, productive crops suited to local agroclimatic conditions can generate economic returns over the medium and long term. This approach is expected to establish a more balanced relationship between environmental conservation objectives and improvements in community welfare (Nusantara, I. G. N., & Putra, I. M. A., 2024).

These environmental challenges are closely connected to the social and economic conditions of the community. Sustainable environmental management is more likely to be adopted when residents obtain tangible benefits from the activities implemented. In this context, strengthening the local economy through the empowerment of Micro, Small, and Medium Enterprises (MSMEs) is an integral component of village development. MSMEs in Daup Village play a strategic role in creating employment, increasing household income, and maintaining economic activities based on local potential (Aditya Arie, H., & Muhammad Fikry, A., 2021). Products generated by local communities also have the potential to become part of the economic value chain of the Kintamani area, which has a strong tourism appeal.

However, some MSME operators in Daup Village continue to face limitations in using digital technology to support their business activities. Business operations that remain largely conventional tend to restrict marketing reach to consumers located near the place of business. Limited visibility of business locations on digital mapping and navigation platforms may also hinder prospective consumers, particularly tourists, from locating MSME products or business premises. In addition, the suboptimal use of cashless payment systems limits the ability of business operators to fully respond to changing

consumer behavior that increasingly favors practical, rapid, and digitally documented transactions (Belinda, Zahri, A. P., Andini, M., & Zukhri, N., 2021).

These conditions indicate a gap between local economic potential and the digital capacity of some MSME operators. The urgency of digitalization is also reflected in the development of Indonesia's national payment system. Bank Indonesia reported that QRIS transactions throughout 2024 reached 6.24 billion transactions with a total value of IDR 659.94 trillion, while the number of QRIS merchants reached 35.9 million, approximately 92.6% of which were MSMEs. In Bali Province, 857,671 QRIS merchants had been recorded by June 2024, representing annual growth of 25.12%, while the number of users reached 1,040,806, an increase of 27.61%. These data demonstrate that digital payments have become an important component of the commercial ecosystem, including for microenterprises. Therefore, the limited ability of MSMEs in Daup Village to use digital maps, digital information channels, and cashless payments constitutes a relevant capacity gap that can be addressed through mentoring programs. MSME digitalization through the optimization of business-location information on digital maps, stronger business presence within the digital ecosystem, and the introduction of cashless payment systems represents a relatively simple intervention with the potential to directly improve business competitiveness (Prasetyo, H., & Rahayu, S., 2023).

Furthermore, Daup Village's location within the tourism-oriented Kintamani area creates opportunities to connect agriculture, environmental management, and MSMEs within a mutually reinforcing local economic ecosystem. Agricultural products and community-processed products can be developed into value-added commodities, while greater digital visibility of MSMEs can help connect local products with consumers and tourists. At the same time, waste management and environmental conservation can strengthen the village's image as an area that is not only economically productive but also committed to environmental sustainability. Consequently, addressing environmental challenges and strengthening the community economy should not be regarded as separate agendas, but rather as components of an integrated village-development strategy.

Based on these conditions, an integrative, participatory, and locally grounded community service program is required in Daup Village. The program, implemented by an academic team together with Warmadewa University students participating in the Kuliah Kerja Nyata (KKN; student community service) program, was designed to address two principal groups of challenges: strengthening environmental management and enhancing community economic capacity. In the environmental dimension, the program focused on improving community awareness and skills in waste sorting, strengthening the functions of the Waste Bank, processing organic waste into compost, and planting productive trees and vegetation that support soil and water conservation. In the economic dimension, the program focused on strengthening the digital capacity of MSMEs by optimizing business visibility on digital maps and introducing and assisting the adoption of cashless transaction systems (Prasetyo, H., & Rahayu, S., 2023).

This approach is expected to generate changes that extend beyond the implementation period and evolve into community practices that can be sustained over time. Waste sorting can become a new routine in household waste management, organic waste can be recognized as a resource with practical value, and planting activities can become part of ongoing land-conservation efforts. Meanwhile, stronger digital capacity among MSMEs is expected to expand market access, make business locations easier for consumers to find, and encourage more modern and efficient transactions.

More broadly, the program is aligned with the sustainable development agenda embodied in the Sustainable Development Goals (SDGs). Contributions to SDG 8 (Decent Work and Economic Growth) are realized through improvements in the capacity and competitiveness of local MSMEs, particularly through the use of digital technology and cashless payment systems. SDG 12 (Responsible Consumption and Production) is supported through waste sorting, strengthening the Waste Bank, and processing organic waste into compost, thereby introducing circular-economy principles at the community level. SDG 13 (Climate Action) is supported by reducing the potential emissions associated with poorly

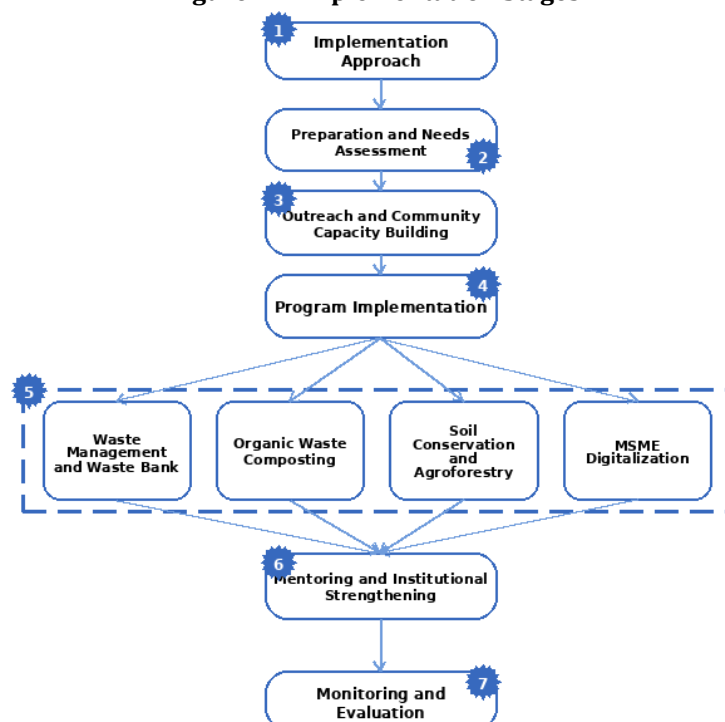
managed organic waste and by increasing vegetation cover. SDG 15 (Life on Land) is advanced through soil and water conservation, erosion prevention, and the planting of productive trees that support the sustainability of terrestrial ecosystems.

Thus, the community service program in Daup Village is intended not only to address short-term problems but also to establish a foundation for behavioral change and greater community capacity to manage village resources in a more productive and sustainable manner. The integration of waste management, organic-waste utilization, land conservation, and MSME digitalization is expected to create an empowerment model that links ecological and economic dimensions (United Nations, 2015). Through the active involvement of community members, the village government, MSME operators, environmental-management groups, students, and academics, Daup Village has the opportunity to optimize its local potential while strengthening environmental and economic resilience in response to future development challenges.

2. METHODS

This community service activity was conducted in Daup Village, Kintamani, Bali, in August 2026. The implementation adopted a Participatory Rural Appraisal (PRA) approach, in which community members and partners were positioned not merely as beneficiaries, but as active actors directly involved in program planning, implementation, and evaluation. A total of 30 partner participants were intensively involved, representing four key village stakeholder groups: the Daup Village Office, the Tourism Awareness Group (Pokdarwis), farmer groups, and members of the general community.

Figure 1.1 Implementation Stages



2.1. Implementation Approach

The community service program in Daup Village was implemented through participatory, educational, demonstrative, and continuous mentoring approaches. The participatory approach positioned community members as the primary actors in problem identification, planning, implementation, and program evaluation. The academic team and Warmadewa University KKN students served as facilitators, mentors, and capacity-building partners, while the village government, community groups, Waste Bank managers, MSME operators, and farmer groups acted as the principal

implementation partners. This approach was selected because the challenges in Daup Village are interrelated across environmental, agricultural, and economic dimensions. Accordingly, the program did not address these issues through isolated activities, but through the integration of four main interventions: (1) strengthening waste sorting and management, (2) processing organic waste into compost, (3) soil and water conservation through productive vegetation and agroforestry, and (4) MSME digitalization through optimized digital mapping and cashless payment systems. Operationally, implementation was organized into five main stages: preparation and needs assessment, outreach and capacity building, program implementation, mentoring and institutional strengthening, and monitoring and evaluation.

2.2. Preparation and Needs Assessment

The first stage was conducted to obtain an overview of current conditions in Daup Village and to ensure that the interventions were aligned with community needs. Activities began with coordination among the academic team, KKN students, the Daup Village Government, community groups, Waste Bank managers, farmer groups, and MSME operators. The needs assessment was conducted through field observations, interviews, focus group discussions (FGDs), and documentation of baseline conditions. In the environmental dimension, the assessment identified waste-accumulation points, household waste-sorting practices, dominant types of agricultural organic waste, the condition of Waste Bank facilities, and potential sites for composting and vegetation planting. In the economic dimension, the assessment covered MSME profiles, product types, marketing conditions, the presence of business locations on digital maps, the use of digital media, and the use of cashless payment systems. The assessment results were subsequently used as baseline data to determine activity priorities, target groups, intervention sites, and program-success indicators.

2.3. Outreach and Community Capacity Building

After baseline conditions had been identified, outreach activities were conducted for community members and target groups concerning the relationship among environmental management, land conservation, and local economic strengthening. The outreach used interactive extension methods, discussions, visual materials, and simple demonstrations so that the information could be understood and applied in practice. Environmental materials covered source-based waste sorting, distinctions between organic and inorganic waste, the benefits of the Waste Bank, composting of organic waste, and the importance of vegetation in reducing erosion and maintaining hydrological functions. Materials for MSME operators covered the importance of a digital business identity, optimization of location information on digital mapping platforms, the use of digital media for promotion, and the use of the QRIS payment system. Capacity building followed a learning-by-doing principle so that community members not only received theoretical information but also directly practiced the skills introduced.

2.4. Implementation of the Waste Management and Waste Bank Program

The waste-management program was designed to establish the habit of sorting waste at its source. Activities began by introducing waste categories and sorting mechanisms, followed by the provision or optimization of sorting facilities according to existing village conditions. Community members were encouraged to separate organic waste, economically valuable inorganic waste, and residual waste. Inorganic waste with market value was then collected and directed through the Waste Bank mechanism. The KKN team provided assistance with record keeping, classification of waste types, and simple management procedures that could be readily adopted by the community. To improve program sustainability, Waste Bank managers were encouraged to implement a straightforward administrative system that records the number of members, waste types, the volume or weight of waste collected, and the economic value generated. These data serve as indicators for measuring changes after program implementation.

2.5. Implementation of Organic Waste Composting

Sorted household and agricultural organic waste was used as raw material for compost production. Activities were conducted through demonstrations and hands-on practice, with community groups or farmer groups serving as the principal implementers.

The composting process comprised the following stages:

- 1) sorting and collecting organic materials;
- 2) reducing material size when necessary;
- 3) mixing organic materials with supporting materials as required;
- 4) arranging the materials in a composting area or container;
- 5) regulating moisture and aeration;
- 6) turning the materials periodically;
- 7) monitoring the decomposition process; and
- 8) harvesting and utilizing mature compost.

The compost produced was intended for reuse on community agricultural land, thereby creating a more closed-loop waste-utilization cycle. Agricultural waste is therefore not only reduced in the environment but also converted into a useful input for agricultural production.

2.6. Soil Conservation and Agroforestry Development

Conservation activities focused on increasing vegetation cover in locations prone to erosion or requiring stronger vegetative protection. Plant species were selected by considering agroclimatic suitability, land conditions, community needs, and both economic and ecological benefits. Planting was conducted participatively with the community through several stages, including site selection, land preparation, determination of seedling types and quantities, planting, installation of markers, and plant maintenance. Productive crops suited to local conditions can be combined with ground-cover or conservation vegetation to establish an agroforestry approach. This method is expected to provide ecological benefits by reducing erosion risk, increasing water infiltration, protecting soil structure, and increasing vegetation cover. At the same time, productive plants can generate economic benefits for the community over the medium and long term.

2.7. MSME Digitalization Implementation

MSME digitalization was carried out through direct mentoring of business operators targeted by the program. The initial stage involved identifying the digital readiness of each MSME, including the availability of business information on digital maps, the completeness of contact and location information, the use of social media, and readiness to adopt digital payments.

Subsequent mentoring activities included:

- 1) assisting MSME operators in ensuring that their business locations could be found on digital mapping platforms;
- 2) improving basic business information such as the business name, address, contact number, operating hours, and business category;
- 3) strengthening digital business identity and product-information materials;
- 4) providing education on the use of digital media for promotional purposes;
- 5) providing information on the benefits of cashless transactions;
- 6) assisting with the use of QRIS in accordance with service-provider procedures; and
- 7) conducting cashless-transaction simulations so that business operators could use the system independently.

A one-on-one, hands-on mentoring approach was used because the level of digital capability varies among MSME operators. Program success was therefore measured not only by the number of MSMEs participating in outreach activities, but also by the number able to operate digital tools independently after receiving assistance.

2.8. Mentoring and Institutional Strengthening

To ensure that the program would continue after the KKN period ended, the capacity of local groups expected to sustain program activities was strengthened. In the environmental dimension, strengthening efforts targeted Waste Bank managers, community groups, and farmer groups. In the economic dimension, they targeted MSME operators and business groups.

The team provided simple guidance on the division of responsibilities, record-keeping mechanisms, activity schedules, facility maintenance, and reporting procedures. In addition, communication mechanisms were established between community groups and the village government so that activities could continue to be monitored after the KKN team completed its service period.

2.9. Monitoring and Evaluation

Monitoring was conducted periodically throughout program implementation to assess the extent to which activities were carried out and to identify obstacles arising in the field. Evaluation was conducted by comparing conditions before the program (baseline) and after implementation (endline).

Table 2.1 Evaluation Indicators

Aspect	Success Indicator
Waste Sorting	Increase in the number of households/groups practicing waste sorting
Waste Bank	Increase in the number of members, volume of waste collected, and consistency of record keeping
Composting	Availability of a composting unit/method and increased volume of organic waste utilized
Conservation	Number of seedlings planted and percentage of plants surviving after the monitoring period
Community Knowledge	Increase in knowledge scores before and after outreach activities
Digital MSMEs	Number of MSMEs with active and complete business information on digital maps
Digital Payments	Number of MSMEs that have started using or are ready to use QRIS
MSME Capacity	Improved understanding among business operators regarding digital promotion and transactions
Sustainability	Presence of local groups/managers that continue program activities after completion

Community knowledge can be assessed through pre-tests and post-tests, while changes in practices are evaluated through observation and interviews. Quantitative data, including the number of participants, the number of households sorting waste, the volume of waste managed, the amount of compost produced, the number of seedlings planted, the number of MSMEs digitalized, and the number of MSMEs using cashless payments, are recorded as indicators of program achievement.

2.10. Partner Participation

Program success depends heavily on the active involvement of partners. The division of roles was therefore designed as follows:

Table 2.2 Roles and Functions of Each Partner

Partner	Form of Participation
Daup Village Government	Coordination, facility support, community mobilization, and program sustainability
Community Members	Waste sorting, composting, plant maintenance, and application of training outcomes
Waste Bank Managers	Collection, record keeping, and management of inorganic waste
Farmer Groups	Agricultural-waste management, composting, planting, and vegetation maintenance
MSME Operators	Participation in training, completion of digital business information, and adoption of cashless transactions
KKN Students	Outreach, technical assistance, documentation, monitoring, and evaluation
Academic Team	Program design, knowledge transfer, supervision, evaluation, and sustainability strengthening

2.11. Target Outputs

The program was designed to generate physical outputs, capacity improvements, and behavioral changes within the community. Physical outputs include the availability of waste-sorting facilities or systems, the implementation of organic-waste composting, and the planting of productive vegetation at target locations. Non-physical outputs include improvements in community knowledge and skills related to waste management and land conservation, as well as stronger digital capacity among MSME operators. More specifically, the program is expected to produce a community-empowerment model based on environmental-economic integration: a model linking household and agricultural waste management, land-resource conservation, and MSME digitalization. This model is expected to be replicable in other community groups or areas with similar characteristics.

2.12. Alignment of Methods with the SDGs

The implementation methods were designed so that each activity would make a measurable contribution to the targeted SDGs. MSME digitalization and capacity building contribute to SDG 8; waste management and composting support SDG 12; reductions in unmanaged organic waste and increases in vegetation cover support SDG 13; and productive-tree planting, soil conservation, and erosion control support SDG 15. Under this approach, program success is assessed not merely by the number of activities completed, but by changes in capacity and behavior, the volume of resources successfully managed, the number of community members involved, and the continuity of practices after the program ends. The approach is expected to position Daup Village as an example of community empowerment that integrates environmental sustainability with local economic strengthening.

3. RESULTS AND DISCUSSION

3.1. Increased Community Awareness and Participation in Waste Management

Program implementation demonstrated that a participatory approach was an important factor in increasing community engagement in environmental management. Outreach activities and hands-on waste-sorting practices helped participants understand that waste is not entirely material that must be discarded; some fractions can be separated, reused, and assigned economic value. Source separation is an important initial step because it improves the quality of materials available for both Waste Bank activities and organic-waste processing.

The results were reflected in participants' improved understanding of the differences among organic waste, economically valuable inorganic waste, and residual waste. Hands-on activities also helped community members recognize that waste management can be carried out through simple actions at the household level. These findings reinforce the relevance of education combined with practical experience (learning by doing) compared with one-way extension activities, because participants directly experience waste-sorting and management practices.

In the context of Daup Village, these results are particularly important because approximately 94.1% of the village consists of agricultural land, plantations, and cultivated fields. This strong agricultural base indicates a continuous supply of organic materials, while at the Bangli Regency level waste generation reached approximately 113.86 tons per day in 2024. Strengthening community capacity for waste sorting therefore represents an initial step toward reducing the amount of waste ultimately treated as residual material while creating opportunities to recover materials that retain economic or functional value.

3.2. Utilization of Organic Waste through Composting

The organic-waste management program improved community skills in processing organic materials into compost. Demonstrations and hands-on practice enabled participants to understand the composting process, including material sorting, size reduction, mixing, moisture regulation, turning, and compost harvesting. These activities helped shift community perceptions of organic waste from discarded material to a resource that can be returned to agricultural production systems.

From an ecological perspective, composting can reduce the amount of organic waste that is burned or openly discarded. From an agronomic perspective, compost can serve as a source of organic

matter that improves soil condition. This is particularly relevant to Daup Village, where most land is used for agricultural activities. Returning organic material to agricultural land allows waste management to be integrated with agricultural production systems, creating an approach more closely aligned with circular-economy principles.

These results also support SDG 12 by encouraging more responsible consumption and production practices. At the same time, reducing the open disposal or burning of organic waste can contribute to SDG 13 because more controlled management of organic materials can reduce environmental impacts relative to open-disposal practices. Nevertheless, quantitative measurement of emissions impacts requires further assessment; at this stage, achievement is more appropriately evaluated based on the volume of organic material successfully utilized and the sustainability of composting practices.

3.3. Strengthening the Waste Bank and the Economic Value of Inorganic Waste

Assistance to the Waste Bank focused not only on waste collection but also on strengthening record-keeping systems and sorting by material type. Program results indicated that more structured management made it easier for community members to understand the relationship between waste sorting and economic value. Inorganic waste that might otherwise become residual waste can be separated, collected, and channeled through the Waste Bank mechanism (Indrawan et al., 2022).

Strengthening simple administrative procedures, including records of members, waste types, waste weight or volume, and economic value, is an important component of program sustainability. These data can provide a basis for Waste Bank managers and the village government to evaluate the development of the Waste Bank over time. Accordingly, the success of the Waste Bank depends not only on the availability of facilities, but also on consistent community participation and the ability of managers to operate the system routinely.

3.4. Soil Conservation through Productive Vegetation Planting

The planting of productive vegetation and ground-cover plants increased vegetation cover at target locations and strengthened community involvement in soil-conservation efforts. Planting was conducted participatively so that community members were involved not only during planting activities but were also encouraged to understand the importance of maintaining the vegetation after the program had ended.

The agroforestry approach offers advantages because it combines ecological and economic functions. Vegetation helps protect the soil surface from the direct impact of rainfall, strengthens soil structure through root systems, and can increase infiltration (Fermana, R., Kusnarta, I. G. M., & Padusung, 2023). Meanwhile, productive plants can generate economic benefits for the community. Conservation activities are therefore not positioned as restrictions on land use, but as strategies for maintaining land productivity over the long term.

In relation to SDG 15, these activities support the protection of terrestrial ecosystems by increasing vegetation cover and reducing the potential for land degradation. Their contribution to SDG 13 is also reflected in increased vegetation that may support carbon sequestration. However, changes in erosion rates and the amount of carbon stored require longer monitoring periods. More appropriate early-stage indicators therefore include the number of plants established, plant-survival rates, and the area or location in which vegetation cover has been successfully increased.

3.5. Strengthening the Digital Capacity of MSME Operators

In the economic dimension, digitalization assistance increased MSME operators' understanding of the importance of maintaining a business presence within the digital ecosystem. Direct mentoring helped business operators improve information such as business names, locations, contact details, operating hours, business categories, and other supporting information on digital mapping platforms. Although relatively simple, these measures are important because they make it easier for consumers and tourists to locate business premises.

In addition to location visibility, MSME operators gained a better understanding of the benefits of cashless transactions through QRIS. Hands-on practice and transaction simulations helped reduce barriers to technology adoption that had previously arisen from limited knowledge. These results suggest that individualized mentoring is more effective for introducing technology to business operators with varying levels of digital literacy.

The need for digitalization is increasingly relevant given the development of digital payments in Indonesia. Bank Indonesia recorded 35.9 million QRIS merchants in 2024, approximately 92.6% of which were MSMEs. In Bali Province, the number of QRIS merchants had reached 857,671 by June 2024. These figures indicate that digital payments have become an important component of economic activity and provide a strong rationale for strengthening the capacity of MSMEs in Daup Village so that they are not left behind by changes in consumer behavior.

3.6. Integration of Environmental and Economic Programs

One important program outcome was the establishment of linkages between environmental and economic interventions. Waste management can generate economic benefits through the Waste Bank, while composting produces inputs that can be reused in agricultural activities. Productive-plant cultivation, meanwhile, combines conservation functions with potential medium- and long-term income. MSME digitalization further expands opportunities for local products and economic activities to be more readily discovered by consumers.

This integration demonstrates that sustainable village development does not require environmental and economic programs to be implemented separately. Instead, both dimensions can be designed as part of a single empowerment pathway. Agricultural waste can become raw material for compost, compost can be returned to farmland, productive plants can strengthen conservation while generating economic returns, and MSMEs can use digital technology to expand their markets. This pattern creates a reciprocal relationship among resource management, productivity improvement, and stronger community economic capacity.

3.7. Program Contributions to the SDGs

Overall, program implementation demonstrated a clear relationship between the activities undertaken and the targeted SDG indicators. SDG 8 was supported by strengthening the digital capacity of MSMEs and access to cashless transactions. SDG 12 was advanced through waste sorting, strengthening the Waste Bank, and processing organic waste into compost. SDG 13 was supported by reducing open management or disposal of organic waste and increasing vegetation cover, while SDG 15 was strengthened through productive-vegetation planting and soil-conservation efforts.

To ensure that these achievements can be assessed more objectively, program evaluation should use quantitative indicators, including the number of participants, changes in knowledge scores based on pre-tests and post-tests, the number of households practicing waste sorting, the weight or volume of waste entering the Waste Bank, the quantity and weight of organic material composted, the number of seedlings planted and the percentage surviving, and the number of MSMEs with active digital business information that have adopted cashless transactions. Collecting these data is important so that program success is evaluated not merely on the basis of whether activities were implemented, but also on the changes generated within the community.

3.8. Program Sustainability

Sustainability is a critical consideration because most environmental and conservation outcomes cannot be achieved through short-term interventions alone. Accordingly, program sustainability was pursued by strengthening the roles of Waste Bank managers, farmer groups, MSME operators, and the village government. Local groups were encouraged to continue record keeping, waste collection, composting, plant maintenance, and the use of digital tools after the KKN program ended.

With stronger local institutions and a simple monitoring system, the program is expected to move beyond a ceremonial activity and become part of routine community practice. Such continuity is an

Community Service : Sustainability Development

important indicator that the community service program has generated changes in capacity and behavior rather than merely producing physical outputs. Ultimately, the integration of environmental management, land conservation, and MSME digitalization can provide a foundation for developing Daup Village as a community with both ecological resilience and stronger local economic competitiveness.

4. CONCLUSION

The community service program in Daup Village demonstrates that local environmental and economic challenges can be addressed more effectively through an integrated, participatory approach grounded in village potential. Daup Village's highland characteristics, with approximately 94.1% of its territory consisting of agricultural land, plantations, and cultivated fields, provide substantial opportunities for organic-waste management, soil and water conservation, and the strengthening of an agriculture-based local economy. At the same time, the presence of MSMEs represents an important asset for increasing community income and competitiveness through the use of digital technology.

Activities involving waste sorting, strengthening the Waste Bank, processing organic waste into compost, planting productive vegetation, and digitalizing MSMEs contributed to improvements in community knowledge, skills, and awareness regarding sustainable resource management. Processing organic waste into compost reinforces circular-economy principles by returning organic matter to agricultural land, while the Waste Bank creates opportunities to recover economically valuable inorganic waste. Productive-vegetation planting also integrates conservation functions with potential economic benefits for the community.

In the economic dimension, MSME digitalization assistance, optimization of business-location information on digital maps, and the introduction of cashless payments through QRIS represent strategic measures for increasing business operators' readiness to respond to changing consumption patterns. These capacity improvements are highly relevant to the development of the digital-payment ecosystem in Indonesia and Bali, giving MSMEs in Daup Village greater opportunities to expand market reach, improve transaction convenience, and attract consumers and tourists.

Overall, the program supported progress toward SDGs 8, 12, 13, and 15 through the integration of community economic strengthening, waste management, environmental-impact reduction, and terrestrial-ecosystem conservation. However, outcomes such as reductions in waste volume, increases in MSME income, decreases in erosion rates, and impacts on carbon emissions require longer-term monitoring. Program sustainability therefore needs to be reinforced through the continued involvement of the village government, Waste Bank managers, farmer groups, MSME operators, and community members as the principal implementers after the community service program has ended.

Thus, an empowerment model integrating environmental management, land conservation, and economic digitalization represents a relevant approach for Daup Village. Sustained waste sorting, composting, vegetation maintenance, and the use of digital technology by MSMEs are expected to strengthen ecological resilience while improving community economic competitiveness. Ultimately, the program is oriented not only toward solving short-term problems, but also toward building the community's capacity to manage village potential independently, productively, and sustainably.

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Community Service : Sustainability Development

that the synergy among the university, students, village government, and community can be sustained to support the development of an empowered, self-reliant, and sustainable Daup Village.

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