

Original Research

Pentahelix Approach in Community Empowerment-Based Ecotourism: Turtle Conservation and Waste Management on Santen Island Beach, Banyuwangi

Jayanti Dian Eka Sari^{1,4*}, Aditya Yudhana^{2,5}, Melati Octavia Febriana¹, Syahrul Novenda Ramadhanny¹, Firrial Eksa Maulidania Putri¹, Suhainizam Bin Muhamad Saliluddin³ and Ratih Novita Praja^{2,5}

¹Public Health Study Program, Faculty of Health, Medicine, and Life Sciences, Universitas Airlangga, Banyuwangi 68425, Indonesia

²Veterinary Medicine Study Program, Department of Health and Life Sciences, Faculty of Health, Medicine, and Life Sciences, Universitas Airlangga Banyuwangi 68425, Indonesia

³Department of Community Health, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia, Serdang 43400, Malaysia

⁴Research Group Women and Child Health and Wellbeing, Universitas Airlangga, Banyuwangi 68425, Indonesia

⁵Research Group for Animal Biomedical and Conservation, Universitas Airlangga, Banyuwangi 68425, Indonesia

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*Correspondence:

Jayanti Dian Eka Sari

Address: Public Health Study Program, Faculty of Health, Medicine, and Life Sciences, Universitas Airlangga, Banyuwangi 68425, East Java, Indonesia.

Email: jayantidian@fkm.unair.ac.id

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ABSTRACT

Background: Santen Island Beach, Banyuwangi, faces significant challenges from waste mismanagement and its impact on marine ecosystems, particularly the endangered sea turtles. This study addresses these issues through a community empowerment program grounded in the Pentahelix framework, engaging stakeholders from government, academia, businesses, communities, and media. The program, active since 2022, aims to integrate sustainable waste management and turtle conservation into community development.

Methods: The study employed a community empowerment approach, incorporating waste segregation, educational tourism initiatives, and turtle conservation training. Collaborations with local organizations like the Banyuwangi Sea Turtle Foundation and waste management entities ensured resource and expertise mobilization. Activities included waste alms programs and sea turtle egg relocation to sandless hatching boxes, supplemented by training and social media campaigns.

Results: The program achieved key milestones, such as forming empowered cadres for waste management and turtle conservation, introducing effective waste segregation practices, and increasing hatchling survival rates through innovative relocation techniques. Outputs included community-led eco-tourism branding, scientific and media publications, and economic benefits for local stakeholders.

Conclusion: This initiative highlights the potential of integrating environmental conservation and economic empowerment within a sustainable development framework. By leveraging the Pentahelix model, the program fosters local ownership and long-term impact, addressing SDG goals related to responsible consumption and marine ecosystem preservation. Continued efforts, such as enhancing cadre competencies and optimizing ecotourism branding, are recommended.

for sustained outcomes.

Keywords: Community empowerment; waste management; sea turtle conservation; Pentahelix model; sustainable ecotourism

1. INTRODUCTION

Waste is the residue of daily human activities or from natural processes in solid form. According to data from SIPSN (National Waste Management Information System) in 2019, Indonesia produced around 66-67 million tons of waste. This number is higher than the amount of waste per year which reaches 64 million tons. The type of waste generated is dominated by organic waste which reaches around 60 percent and plastic waste which reaches 15 percent. East Java ranks second in the province with the highest waste generation in 2021, around 1.28 million tons. Meanwhile, Banyuwangi is the first ranked district with the largest waste generation in East Java with a total generation of 457 thousand tons per year.⁽¹⁾ Banyuwangi Regency has a variety of natural tourism potential, one of the favorite tours in Banyuwangi is Santen Island Beach. The development of Banyuwangi's tourism industry is currently very rapid, this is evidenced by the increasing number of tourists traveling to Banyuwangi every year. The increasing number of tourists and activities carried out to increase economic growth will affect the increasing volume of waste in Banyuwangi Regency. The distribution of waste consists mostly of plastic waste, while at the edge of the beach, the waste consists of santen tree leaves and some tree trunks carried by the current.⁽²⁾

The amount of waste in the environment has a negative impact on health, which can cause skin diseases, cholera, diarrhea, and dengue fever can also increase rapidly in areas where waste management is inadequate.⁽³⁾ Poor and improper waste management will cause inconvenience to tourists visiting the tourist sites and can affect the decline in community visits, this decline in visitors affects the income of the coastal community of Santen Island Banyuwangi. Garbage scattered in the surrounding environment causes inconvenience and aesthetic disturbances, reducing the beauty and comfort of human life. Waste problems can also trigger social conflicts among residents, especially related to the rejection of waste disposal sites or dissatisfaction with waste collection services. A

rundown and dirty environment caused by waste can be a breeding ground for crimes such as theft and drug abuse.⁽⁴⁾ The negative impact of waste is not only on health, financial and social aspects, but also on biota and the stability of marine ecosystems

Sea turtles have been an important part of Indonesia's marine ecosystem for centuries.⁽⁵⁾ However, various threats have increased the risk of extinction for these beautiful and important creatures. One of the most serious threats faced by sea turtles is illegal consumption. Despite regulations prohibiting the hunting and consumption of sea turtles, there are still individuals who ignore them, motivated by traditional beliefs about the benefits of sea turtle meat and eggs.⁽⁶⁾ This poaching, both for consumption and for sale on the black market, has led to significant declines in sea turtle populations.⁽⁷⁾ However, the threats to sea turtles do not stop with poaching. Sea turtles are one of the marine animals affected by the presence of garbage on the coast of Santen Island. Turtles think that plastic waste is food so enters their digestive tract, besides that turtles are often entangled by plastic waste until they drown. These events have caused sea turtles to become one of the most endangered marine fauna and their population is declining every year.⁽⁸⁾

The negative impact of waste is not only on health, economic, and social aspects, but also on biota and the stability of marine ecosystems. The Santen Island Beach community also recognizes that there are people who find turtle eggs and trade them illegally. Waste management on Santen Island is also poor, as evidenced by the hoarding of waste using beach sand and the Santen Island Beach Community does not have a fixed TPS. Therefore, an alternative solution is needed to reduce waste in the environment and prevent the extinction of protected marine animals such as sea turtles. The efforts that have been made at Santen Island Beach are community service through community empowerment. In 2023, community service at Santen Island Beach has succeeded in creating 20 waste management cadres and turtle conservation cadres. Waste management and sea turtle conservation cadres act as community mobilizers in understanding the importance of waste segregation, maintaining

environmental cleanliness and preventing the threat of extinction of sea turtles as protected marine animals. They are also tasked with disseminating information and knowledge on how to properly manage waste and how to relocate sea turtle eggs to the community.⁽⁹⁾

The cadres that have been formed are still incompetent in terms of skills, knowledge, and persuasive communication. This means that these cadres still need empowerment or training so that they can be empowered from all aspects. The purpose of cadres in the Santen Island Beach Community is to assist in the process of supervision, management, and as a means of providing education about the importance of waste management and turtle egg relocation to the Santen Island Beach community. The need to deliver education to the community is an initial process in changing mindsets and increasing public knowledge of the importance of waste management and turtle egg relocation so that people become aware and can play a direct role in maintaining environmental health and preventing the extinction of protected marine animals such as sea turtles.⁽¹⁰⁾ The objective of this community development activity is to empower the community in independently identifying, addressing, and managing environmental issues through synergy with the five main elements of Pentahelix development including government, business actors, academics, communities, and media. This activity is expected to enhance public awareness of environmental issues and improve community welfare through economic development initiative.

2. METHODS

2.1 Study Design

The method used in the implementation of this activity is the Community Empowerment approach with the Pentahelix framework. This approach aims to empower communities to identify, address, and manage environmental problems independently through synergy with the five main elements of development: government, business, academia, community, and media.⁽¹¹⁾ In the context of this activity, community empowerment is carried out to raise awareness of the preservation of the beach environment and turtle ecosystem, empower the community in sustainable waste management, and build the community's ability to utilize environmentally friendly technology such as solar panels.

Our collaborative partners in this activity are Banyuwangi Sea Turtle Foundation (BSTF) which is competent in the aspect of turtle conservation; Bank Sampah Banyuwangi (BSB), Eco Laku Lestari Foundation, and Sky Farm Foundation which is competent in the aspect of waste management; and PT Bank Mandiri Taspen which supports the strengthening of tourism sites based on environmental conservation. Collaboration with these partners ensures that each element of the program is managed professionally and sustainability-oriented.

The Pentahelix model is implemented through multi-stakeholder collaboration. In the waste management program, the community is involved in sorting and managing waste by utilizing facilities such as waste bins and technology provided by collaborating partners. Academics provide waste management training, media disseminate information and education, while the government supports relevant policies. In the turtle conservation program, the community is trained to use sandless turtle egg hatching tools provided by the partners, supported by government regulations, technical guidance from academics, and the role of the media in raising awareness about conservation. The Pentahelix approach was chosen because it offers a holistic solution by involving all elements of development, creating a collaboration that empowers the community as the main subject, not just the object of intervention. This multi-stakeholder synergy supports program sustainability as it ensures communities have the capacity, resources, and support to continue the initiatives that have been started.

This community service activity has been ongoing since 2022 and is designed as a sustainable program until 2026. In 2022, the focus of activities was on sea turtle conservation and coastal vegetation in the Santen Island Beach area, Banyuwangi. Then, 2023 was the beginning of the initiation of educational tourism and sea turtle conservation as an effort to empower local communities. In 2024, turtle conservation management was strengthened by optimizing social media content and ecotourism branding to increase the attractiveness of the area. The program continued in 2025 with the optimization of turtle conservation eco-tourism, which involved training in natural, semi-natural, and artificial nest management. Furthermore, in 2026, this activity is directed at improving the community's economy through the turtle conservation eco-tourism program package. Through this approach, activities are expected

to integrate environmental conservation and economic empowerment of local communities, creating sustainability through education, training, and strengthening ecotourism. This activity also supports the Sustainable Development Goals (SDGs), especially Goal 14: Life Below Water by contributing to the restoration of marine ecosystems and sea turtle habitat health through community-based waste management, while inviting the community to be active in environmental management to reduce plastic waste and support marine ecosystems. In addition, this program

synergizes with Goal 12: Responsible Consumption and Production by encouraging responsible production and consumption patterns, so that people can utilize waste as a valuable resource and strengthen awareness of environmental sustainability.

2.2 Flowchart of Waste Management Program Implementation

The flowchart of the waste management program implementation is presented in Figure 1.

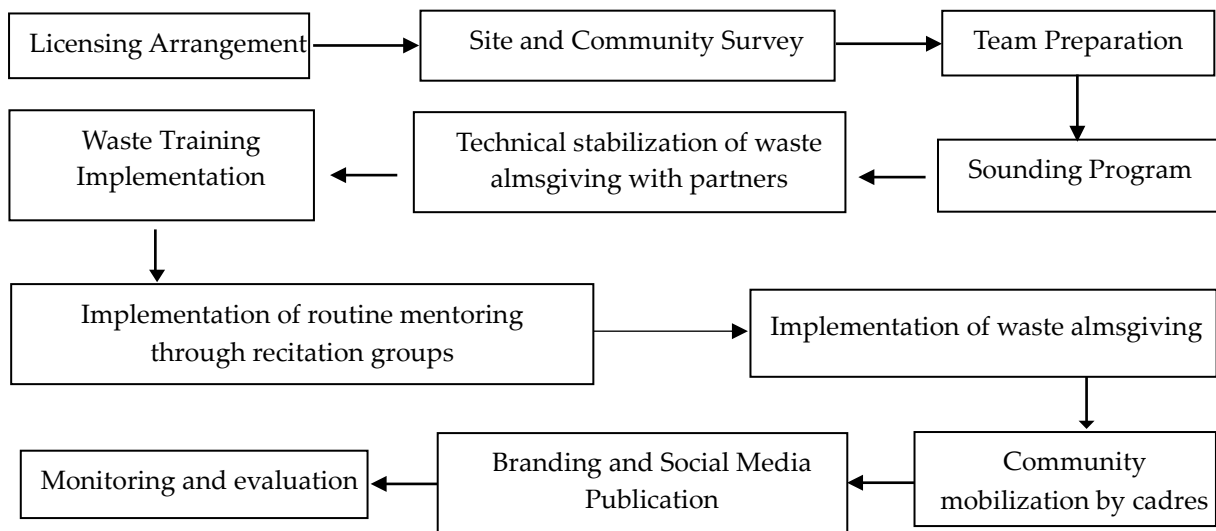


Figure 1. Waste management program flow chart

2.3 Implementation of Sea Turtle Conservation Program

The success of this community service program is measured through several indicators that include community empowerment, utilization of facilities and

infrastructure, and achievement of the specified outcomes. Monitoring and evaluation are carried out to ensure the improvement of community empowerment, such as the active role of the turtle conservation and waste management cadre groups, as well as the

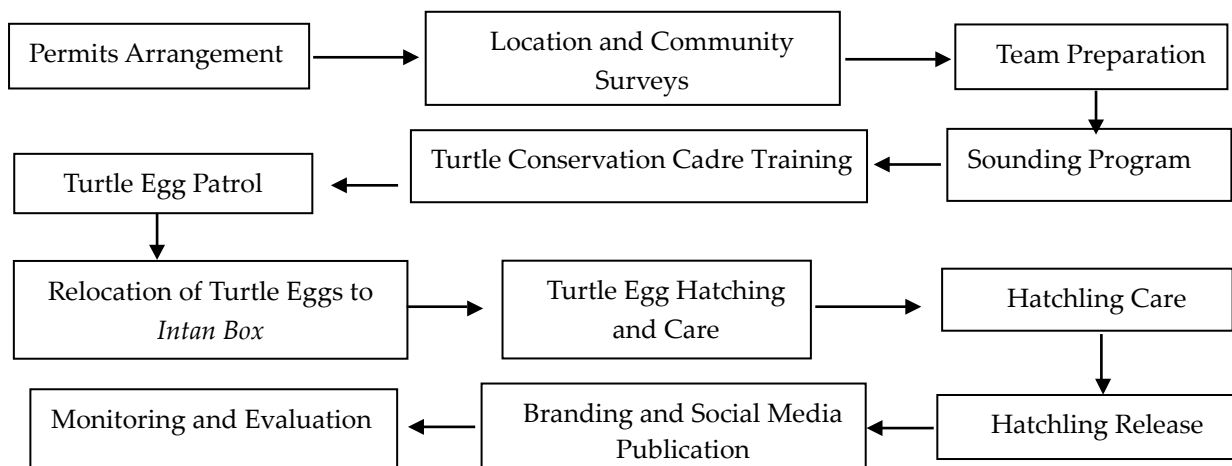


Figure 2. Turtle conservation program flow chart

community's ability to utilize facilities such as greenhouses, incubators, solar power plants, and other supporting facilities. The facilities are also evaluated periodically to ensure that their use is sustainable and well-maintained. In addition, success is measured through the achievement of mandatory outputs, such as publication of articles in Sinta 3 accredited national journals, publication of articles in mass/print media, documentation in the form of videos and photos of activities, as well as economic improvement and environmental health of partner communities. Additional outputs, such as popular articles in mass media and the acquisition of Hak Kekayaan Intelektual (HKI) are also part of the success indicators. Publication of videos of activities on social media and national television is also a promotional strategy for Santen Island, with the hope of bringing in more domestic and international tourists.

2.4 Ethical Clearance

This research also has ethical clearance with reference number: 002/04/KEPK-STIKESBWI/IX/2024-2025. All of these indicators are measured through field

observations, document evaluations, community surveys, and analysis of statistical data from the media and related parties to ensure sustainable impact.

3. RESULTS

Community service activities in the Santen Island Beach area have been running for 3 years and have brought great changes to both the community and the environment. Various efforts that have been made by involving various parties have proven to increase knowledge and develop community skills in waste management and turtle relocation. Various outputs have been produced, some of which is a pocket book "All About Turtles" with copyright number EC00202418733, an activity video entitled "Plastic Waste Management and Santen Island Turtle Conservation" which has been uploaded on the YouTube page, and various popular news articles that have been published by various mass media both on a regional and international scale. Community service on Santen Island Beach supports the achievement of SDGs point 3



Figure 3. Waste training activities for the community at Santen Island Beach

good health and well-being.

The socialization and education programs provided to the community at Santen Island Beach have directly contributed to a significant increase in community knowledge, particularly about waste management and environmental conservation. These initiatives not only create awareness but also foster a sense of responsibility among the residents toward maintaining a clean and sustainable environment.

Regular training sessions and continuous mentoring have further enhanced the community's skills in effectively managing waste, enabling them to turn waste into valuable resources such as ecobricks. This practical approach empowers the community by offering both environmental and economic benefits. The establishment of cadres as part of a structured community empowerment system has played a pivotal role in achieving the objectives of this community

service program. These cadres act as agents of change, bridging the gap between program initiatives and the community by promoting best practices in waste

management and conservation efforts. Their active involvement ensures the program's sustainability and strengthens its long-term impact.



Figure 3. Turtle egg relocation training activities for the community at Santen Island Beach

Economic improvements in the Santen Island Beach community are evident, as the buying and selling of ecobrick products have become a source of additional income for many residents. This has not only boosted household finances but also instilled a sense of entrepreneurship within the community. The waste alms program, where waste is exchanged for financial or social benefits, has further contributed to the realization of community welfare, offering a unique and sustainable approach to addressing economic, and environmental challenges. In addition to economic, and social advancements, the program has positively impacted the environment by significantly reducing waste levels in the area. This has created a cleaner and healthier environment for both residents and visitors. Moreover, the turtle conservation efforts have been successfully implemented, ensuring the protection and sustainability of marine life, particularly sea turtles, which are a vital part of the coastal ecosystem. These combined efforts underscore the holistic approach of the community service program in integrating environmental preservation, community empowerment, and economic development, paving the way for a sustainable future for Santen Island Beach.

4. DISCUSSION

The community service program with the theme “Realization of Sustainable Ecotourism through Community Development Empowerment in the Field of

Plastic Waste Management and Sea Turtle Conservation” has the main objective of strengthening community capacity and creating a source of income for the community around Santen Island Beach. Strengthening community capacity is done by strengthening existing cadres through the implementation of the waste alms program and turtle relocation. The successful implementation of community service at Santen Island Beach cannot be separated from the role of various stakeholders.⁽¹²⁾ Stakeholders in this context are known as the Pentahelix concept consisting of government, academics, community business people, and the media.⁽¹³⁾

The Pentahelix concept is one of the key holders that play a role in tourism development in an area, including Santen Island Beach.⁽¹⁴⁾ The Pentahelix concept adopted in community service at Santen Island Beach is based on the 6P empowerment approach, namely enabling, empowering, protecting, supporting, fostering, and controlling.⁽¹⁵⁾ The role of Pentahelix in terms of empowerment can effectively contribute to the development of tourism villages that are expected to improve the quality of life of village communities through active participation and collaboration of various parties.⁽¹⁶⁾ Referring to this concept, each stage in the implementation of community service at Santen Island Beach is based on the Pentaheli concept.

The first stage in this community service program is the preparation stage. The preparation stage consists

of three steps, namely the licensing stage, a survey of the location of the waste alms and turtle relocation program, and team coordination and preparation. The first step of this stage is the licensing stage which is carried out by various parties to ensure that all community service activities at Santen Island Beach run smoothly and provide maximum benefits. Licensing was carried out with the head of the neighborhood association (RT) of Santen Island Beach, Karangrejo Village, Banyuwangi Subdistrict, 0825 Banyuwangi Military District Command, and V Brawijaya Military Regional Command. Cooperation and collaboration are also carried out with various partners in multidisciplinary science to maximize the results of community service. Partners involved include Nyubrick Turtle Conservation Cadre, Nyubrick Waste Management Conservation Cadre, Karangrejo Social Welfare Group, Santen Island Beach Processors and Marketers Group, Santen Island Beach Tourism Awareness Group, Eco Laku Lestari Foundation, Banyuwangi Sea Turtle Foundation and the Banyuwangi Regency Environment Office.

The second step of this stage is a survey of coastal environmental conditions, especially coastal hygiene conditions. The distribution of waste on the coast of Santen Island Beach is mostly in the form of plastic waste which has an impact on the disruption of fishing activities by fishermen. The mangrove area that separates Santen Island Beach from the mainland also contains a lot of plastic waste that disturbs the aesthetics, and cleanliness around Santen Island Beach. Poor and improper waste management will cause various losses, including the emergence of unpleasant odors, disturbing beauty, causing flooding, increasing global warming, deteriorating environmental sanitation, and the threat of various diseases. It can also cause a sense of discomfort for tourists visiting Santen Island Beach and affect tourists' interest in returning to visit.⁽¹⁷⁾

A site survey was also conducted to find out which areas are often used by sea turtles to lay eggs. Sea turtles tend to prefer to lay eggs in coastal areas that have a gentle slope and dense vegetation.⁽¹⁸⁾ Based on observations at Santen Island Beach, it was found that sea turtles lay many eggs in areas where sea pandanus vegetation grows. Sea turtle eggs found by fishermen will be conventionally hatched by burying the eggs in the conservation area provided. However, over time, the collaboration and cooperation between the

Nyubrick FIKKIA Universitas Airlangga Community Service Team with various parties including Bank Mandiri and the Banyuwangi Sea Turtle Foundation made Santen Island Beach have Intan and Sari Boxes that help hatch turtle eggs more effectively. The Intan and Sari Boxes are located in the Nyubrick Green House which is managed directly by the turtle cadres and monitored by the BSTF and the Nyubrick FIKKIA Universitas Airlangga community service team. Nyubrick Green House is used as a place for turtle relocation training.

The third step taken in the preparation stage is team preparation and coordination. This step is carried out by coordinating with the Nyubrick FIKKIA Universitas Airlangga community service team both internally and externally. External coordination is carried out with the community and work partners for schedules and models for implementing community service that are tailored to the conditions and characteristics of the local community. The empowerment model used is local community-based development. The model emphasizes community participation by providing active and interactive learning experiences to the community, emphasizing the importance of agreement and cooperation between communities, and concern as part of the community.⁽¹⁷⁾ This model seeks to foster motivation, planning, and appropriate action from local community participation to achieve empowerment goals.

The second phase was the implementation of the waste alms program and turtle relocation training. The Nyubrick Team of the Faculty of Health, Medicine and Natural Sciences (FIKKIA) Universitas Airlangga, in collaboration with the East Java Provincial Health Office represented by Mr. Didiék and Mr. Agus from the Banyuwangi Environment Office, conducted socialization of the waste alms program as well as made regulations on the organizational structure of waste alms management to the Santen Island community which was a continuation of the previous year's community service activities. Meanwhile, community empowerment with turtle relocation training in collaboration with the Banyuwangi Sea Turtle Foundation.

The waste alms program aims to turn waste into valuable resources or income. The waste alms program at Santen Island Beach is based on the concept of community empowerment which includes the stages of awareness, capacity, and empowerment. These stages

are continuous and inseparable from one another. The main objective of community empowerment is to train the independence of a community. Independence is an indicator that shows the level of community empowerment. This condition is characterized by the community's ability to make decisions and take actions that are considered appropriate to solve the problems they face, based on their capacity.⁽¹⁹⁾

The waste alms empowerment program is one of the programs that aims to tackle waste as well as become a field of blessings for the Santen Island Beach community. The program that has been developed is structured in the following stages: (a) Creating an organizational structure for the waste alms program which includes a program coordinator, secretary, and treasurer, (b) Waste is collected from the community to the coordinator of the waste alms program (c) The coordinator of the waste alms program contacts the waste collector (d) The waste collector or the Environmental Service will receive the waste that has been collected by the Santen Island Beach community (e) The collector will provide funds from the waste that has been collected (f) Funds are handed over to the community to be managed in joint savings (g) The funds that have been collected are used by the community which are used for common interests.

The implementation of the waste alms program will be monitored by the Nyubrick FIKKIA Universitas Airlangga community service team through regular weekly recitations. Good management of the waste alms program and funds from the sale of waste will produce various benefits for the community and the environment. The positive impact of this waste alms program is the freedom of the community to manage the waste management system. Thus, this empowerment climate can support the welfare of the Santen Island Beach community in accordance with by the needs of the local community. In addition, the waste alms program also helps environmental conservation efforts by reducing the frequency of waste in the Santen Island Beach area.

As a follow-up to environmental conservation efforts, a sea turtle relocation training program was implemented as an effort to preserve the sea turtle population in the open sea. Conservation of sea turtles and protected marine biota is based on the principle that both have important ecological values for coastal ecosystems, so their existence needs to be maintained. One conservation effort that can be done is to relocate

turtle eggs from natural nests to semi-natural nests to reduce direct interaction with tourists and increase hatching success rates. This relocation is carried out by conservation actors as a last resort if the protection of natural nests cannot be implemented effectively.⁽²⁰⁾ The turtle relocation training program was held at the Nyubrick Green House and attended by Santen Island Beach turtle conservation cadres. The activity began with socialization and education from the Banyuwangi Sea Turtle Foundation as an expert in the field of sea turtle conservation. The next activity was training in the form of hands-on practice on how to relocate turtles from the coast to the IntanBox.

The stages of turtle egg relocation include (a) Finding eggs on the coast (b) Moving eggs from the coast to the Intan Box (c) Eggs are carefully transferred to a transparent bottle containing 8 - 14 eggs, the bottle is not filled completely to ensure that the cavity in the bottle is not closed (d) The egg bottle is given the identity of the finder, the place of discovery, number of eggs and date of egg discovery (e) The eggs that have been put into the bottle will be put into the IntanBox for approximately 55 days until the eggs hatch (f) After the eggs hatch, the baby turtle will be moved to the Sari Box to absorb the remaining yolk from the baby turtle (g) After the turtle is strong enough to survive, it will be released to the open sea.

The turtle egg relocation training at Santen Island Beach has various benefits and positive impacts. With this training, the local community can increase their understanding and skills in sea turtle conservation efforts, which are now increasingly endangered. Relocating turtle eggs helps protect the eggs from predators and the risk of environmental damage, increasing the chances of the eggs hatching. In addition, this activity also supports the sustainability of coastal ecosystems, which play an important role in maintaining environmental balance. Other good impacts include increased community awareness of the importance of maintaining biodiversity, as well as opportunities to promote ecotourism in the area, which has the potential to sustainably improve local economic welfare.

The strengths of this program include enhancing cadres' skills and knowledge in waste management and sea turtle conservation, increasing their awareness of these issues, and providing long-term benefits through the empowerment of cadres who can act as agents of change in their communities. However, the program

faces weaknesses such as limited resources, including budget and manpower, as well as challenges in maintaining the long-term commitment of cadres. Opportunities for the program arise from new policies or regulations related to waste management and sea turtle conservation, which can support its implementation. Advances in science and technology also offer the potential to develop innovative waste management systems and modern approaches to turtle conservation. Additionally, the involvement of sponsors provides valuable support for the program's sustainability. On the other hand, the program is threatened by a lack of public awareness regarding the importance of waste management and sea turtle conservation. Furthermore, the presence of similar initiatives by other organizations may divert attention and resources away from this program.

5. CONCLUSION

The community service program titled "Realization of Sustainable Ecotourism through Community Empowerment in Plastic Waste Management and Turtle Conservation" on Santen Island, Banyuwangi, adopts a Pentahelix approach involving government, businesses, academics, communities, and media. Running from 2022 to 2026, it aims to empower communities in sustainable waste management, beach and turtle conservation, and eco-friendly technology use, supported by partnerships with key organizations. The program aligns with SDGs, particularly Goals 12 and 14, through conservation, ecotourism development, and community economic empowerment. Success is measured by community engagement, infrastructure utilization, and outputs like publications, training, and conservation-based tourism promotion.

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Conflict of Interest

The authors declare no conflict of interest.

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