



Tri Hita Karana for environmental resilience: Enhancing coral reef conservation and sustainable practices in Mengiat Beach Bali


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ARTICLE INFO	ABSTRACT
<p>Article history Received: 2023-10-27 Revised: 2024-01-16 Accepted: 2024-01-20 Published: 2024-01-27</p> <p>Keywords Coral reef conservation Environmental resilience International community service Sustainable practices Tri Hita Karana</p>	<p><i>This collaborative international community service initiative applies the Tri Hita Karana philosophy to improve coral reef conservation at Bali's Mengiat Beach. The collaboration between Universitas Ngurah Rai and the University of Canberra integrates traditional wisdom and innovative methods, promoting resilience, sustainable practices, and economic growth while adhering to Tri Hita Karana's holistic principles. The initiative program combines Marine Protected Areas (MPAs) and the Mars Assisted Restoration System (MARRS) to safeguard coral ecosystems. Participatory Action Research (PAR) empowers communities, aligning with the holistic principles of Tri Hita Karana. The methodology encompasses preparation, education, hands-on training, beach clean-ups, and continuous evaluation, reinforcing coral preservation while promoting sustainable practices and ecological well-being. These strategies align with the Tri Hita Karana philosophy, promoting local engagement and resource management. The donation of Reef Stars by the universities to the Bali Coastal and Marine Biodiversity Foundation reflects a commitment to environmental well-being and long-term harmony. The Mengiat Beach collaboration by two universities and the Bali Coastal and Marine Biodiversity Foundation integrates traditional wisdom and modern methods within the Tri Hita Karana philosophy. Through education, training, and reef restoration, the initiative emphasizes community engagement and ecological resilience.</i></p>
<p>Kata Kunci Ketahanan lingkungan Konservasi terumbu karang Pengabdian masyarakat internasional Praktik berkelanjutan Tri Hita Karana</p>	<p>Tri Hita Karana untuk ketahanan lingkungan: Meningkatkan konservasi terumbu karang dan praktik berkelanjutan di Pantai Mengiat Bali. Inisiatif pengabdian masyarakat internasional kolaboratif ini menerapkan filosofi Tri Hita Karana untuk meningkatkan konservasi terumbu karang di Pantai Mengiat Bali. Kolaborasi antara Universitas Ngurah Rai dan University of Canberra mengintegrasikan kearifan tradisional dan metode inovatif, mengedepankan ketahanan, praktik berkelanjutan, dan pertumbuhan ekonomi dengan tetap berpegang pada prinsip holistik Tri Hita Karana. Program inisiatif ini menggabungkan Kawasan Konservasi Laut dan Sistem Restorasi Berbantuan Mars untuk menjaga ekosistem karang. Penelitian Tindakan Partisipatif memberdayakan masyarakat, selaras dengan prinsip holistik Tri Hita Karana. Metodologinya mencakup persiapan, pendidikan, pelatihan langsung, pembersihan pantai, dan evaluasi berkelanjutan, memperkuat pelestarian karang sekaligus mendorong praktik berkelanjutan dan kesejahteraan ekologis. Strategi-strategi ini sejalan dengan filosofi Tri Hita Karana, yang mendorong keterlibatan lokal dan pengelolaan sumber daya. Sumbangan Reef Stars oleh universitas-universitas kepada Yayasan Keanekaragaman Hayati Pesisir dan Laut Bali mencerminkan komitmen terhadap kesejahteraan lingkungan dan keharmonisan jangka panjang. Kolaborasi Pantai Mengiat yang dilakukan dua universitas dan Yayasan Keanekaragaman Hayati Pesisir dan Laut Bali mengintegrasikan kearifan tradisional dan metode modern dalam filosofi Tri Hita Karana. Melalui pendidikan, pelatihan, dan restorasi terumbu karang, inisiatif ini menekankan keterlibatan masyarakat dan ketahanan ekologi.</p> <p style="text-align: right;">Copyright © 2024 Suryawan et al This is an open access article under the CC-BY-SA license</p> <div style="text-align: right;">  </div>

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INTRODUCTION

Our oceans provide an abundance of advantages, from coastal protection to nourishment, livelihoods, and carbon storage, yet they are under increasing strain, threatening their health and the benefits that they provide (Estradivari, et al., 2022). In the face of mounting global environmental challenges, the pursuit of sustainable development has gained utmost importance (Biermann, Kanie, & Kim, 2017). The concept of marine sustainability, which is firmly rooted in the values of responsible use of marine resources, has garnered a lot of attention as a potential framework for bringing seemingly unrelated goals within the larger context of the Blue Economy, which is defined by (Elegbede, Akintola, Jimoh, & Jolaosho, 2023) as the sustainable use of ocean and coastal resources for economic growth, improved livelihoods, and job creation while protecting the health of marine ecosystems. This paradigm has sparked vibrant discussions at the local, national, and international levels by seeking to protect marine ecosystems while advancing economic development.

The Sustainable Development Goals (SDGs) were universally agreed by all UN member states in 2015, enshrining a comprehensive and collaborative call to action to eliminate poverty, protect the environment, and promote global well-being and peace by 2030. The SDGs, which consist of 17 specific objectives, reveal a deep interconnection by acknowledging that actions performed in one domain can have implications in others, emphasizing the importance of striking an optimal equilibrium between social, economic, and environmental sustainability (United Nations, 2018). Preserving the Earth's oceans is a key component of the 17 Global Goals, particularly SDG 14, titled "Life Below Water." The primary goal of SDG 14 is to ensure the sustainable management of marine and coastal ecosystems, which includes initiatives to preserve them from pollution and mitigate the negative consequences of ocean acidification. The underlying rationale for SDG 14 is based on the recognition that the planet's oceans, which are distinguished by their intricate interplay of temperature, chemical composition, currents, and biodiversity, serve as the driving force behind the global systems that maintain habitability for human existence. The judicious management of this invaluable natural treasure is undeniably important, stressing its critical role in creating humanity's future and reducing the far-reaching consequences of climate change. Furthermore, the establishment of Marine Protected Areas (MPAs), which are meant to protect vital marine ecosystems, has the potential to promote sustainable use of marine resources. This approach attempts to not only conserve these essential habitats but also ensure that populations relying on the ocean may reap the benefits of MPA implementation (BAPPENAS, 2021).

Coral reefs, famous for their unmatched variety of life forms, play a crucial role in supporting marine ecosystems and meeting the needs of coastal communities (Hughes, et al., 2018). However, these delicate ecosystems are facing immediate danger due to global warming, contamination, and unsustainable tourism practices (Yonvitner, et al., 2022). Located in the prestigious Nusa Dua, Mengiat Beach is experiencing significant pressures that have resulted in the deterioration of coral formations and a simultaneous decrease in biodiversity. Recognizing the urgency of the situation, a cooperative effort has been organized between the Faculty of Economics and Business at Universitas Ngurah Rai and the University of Canberra. This partnership, additionally facilitated by the Coastal and Marine Biodiversity Foundation Bali, aims to combine traditional knowledge and sustainable methods, thereby enhancing sustainable development by placing a stronger emphasis on the preservation of coral reefs. This approach also aims to overcome the challenges in coral restoration as stated by Boström-Einarsson, et al. (2020) that include 1) The absence of well-defined and attainable goals, 2) The absence of appropriate and standardized tracking and documenting processes, and 3) Efforts that are poorly designed in relation to their intended objectives.

Within this context, the Tri Hita Karana philosophy, deeply ingrained in Balinese customs, emerges as a crucial paradigm that emphasizes the interconnected relationships between humans, nature, and the spiritual realm. For Balinese people, Tri Hita Karana is primarily a valuable, wonderful teaching concept emphasizing three harmonious human interactions in worldly life, especially the relationship between humans and God (Parahyangan), humans and humans (Pawongan), and humans and nature (Palemahan). Each part of a relationship has a life lesson that might help you appreciate the other aspects around you. This Tri Hita Karana is meant to be applied by Balinese society in order for them to enjoy a prosperous and balanced life (Hadiyanto, 2022). By utilizing the principles of Tri Hita Karana, particularly through an international community service program, this endeavor not only demonstrates the potential to enhance environmental resilience but also pledges to elevate the socio-ecological well-being of local communities. Tri Hita Karana also contribute to the cultural preservation and sustainable development of the local community by instilling moral awareness, religious ethics, and ecological wisdom (Adnyani & Purnamawati, 2020).

The Tri Hita Karana philosophy, firmly ingrained in Balinese Hindu traditions, embodies three interconnected relationships: the balance between humans and the divine, between humans and the natural world, and among fellow humans (Yasa, 2022). Subsequently, Astuti, Ginaya, & Susyarini (2019) also explain that Tri Hita Karana timeless philosophy has actively guided Balinese society, fostering a holistic understanding of interdependence and balance. Importantly, within the realm of environmental resilience, the principle of Parahyangan resonates with spiritual reverence for the environment, aligning with contemporary concepts of ecological spirituality. The principle of Pawongan emphasizes the importance of harmonious social interactions, echoing community-focused approaches to conservation and sustainable practices. Furthermore, the principle of Palemahan highlights responsible resource management, echoing modern principles of environmental stewardship (Qodim, 2023).

Additionally, the concept of *Awig-Awig*, or written customary law in Bali, arose in response to the necessity to establish order and harmony within distinct customary communities. These communities, with their distinct traits, required specific methods and rules. The content of *Awig-Awig*, for example, varies according to the distinct natural circumstances of coastal and plain regions. *Awig-Awig* concerns the usage of marine resources and the management of tourism potential in coastal locations. Pandawa Beach in the Kutuh Village area in South of Bali, for example, is a popular tourist site in Bali. The local *Awig-Awig* establishes requirements for beach maintenance, even in the middle of a large tourist influx. *Awig-Awig* governs rituals as well as natural conditions, although the particular procedural parts of these ceremonies vary between villages. This differentiation is a distinguishing feature of *Awig-Awig* in coastal and plain locations. Despite the impact of tourism on Balinese culture, *Awig-Awig* is still relevant in today's globalized world. It is a source of customary law that is supplemented by a more comprehensive implementing regulation called *Pararem*. *Pararem* is designed to the specific needs of indigenous groups as well as the modern situation (Yulianingsih, Indawati, & Kartika, 2021).

Implementing the Tri Hita Karana principle to enhance coral reef preservation at Mengiat Beach requires a diverse strategy that combines ecological knowledge and community involvement, as previously shown by the restoration of coral reefs effort in Pemuteran, Bali (Trialfhianty & Suadi, 2017). In this cooperative endeavor, the Faculty of Economics and Business Universitas Ngurah Rai and the University of Canberra, in partnership with Bali Coastal and Marine Biodiversity Foundation and the local communities, embark on an innovative path of coral conservation. This cooperation demonstrates its dedication to sustainable practices by contributing coral saplings and growth materials. Through this initiative, the universities, local communities, and the foundation collaborate to establish resilient marine protected areas and to enhance waste management practices. Together, they foster a balanced ecosystem that reflects the principles of Tri Hita Karana. The effectiveness of similar collaborative conservation efforts, as demonstrated by community-led initiatives at Tianyar Village in North Bali, reaffirms the efficacy of such comprehensive approaches (Boakes, Mahyuni, Stafford, & Cvitanovic, 2022).

The international community service program, achieved through the collaboration between the Faculty of Economics and Business Universitas Ngurah Rai, the University of Canberra, as well as the Bali Coastal and Marine Biodiversity Foundation, stands as an innovative effort combining ancestral wisdom with technical methodologies. According to Suamba & Utama (2017), the Tri Hita Karana philosophy provides a comprehensive framework that seamlessly aligns with contemporary ecological and sustainability principles. By fostering a deep connection between humanity, nature, spirituality, and with the invaluable support from both universities and the foundation, this cooperative initiative not only revitalizes the coral ecosystems of Mengiat Beach, however it also supports sustainable practices, enhances local resilience, and improves the well-being of the local communities. This form of Traditional Environmental Knowledge (TEK) or Complex Knowledge-Practice-Belief System, as stated by Gómez-Baggethun, Corbera, & Reyes-García (2013), serves as a significant step towards bridging the divide between traditional knowledge and modern innovation, all in the tireless pursuit of advancing environmental conservation and sustainable progress (Kuhn & Duerden, 2021). As explained by (Qodim, 2023), Traditional Ecological Knowledge (TEK) is a beneficial approach to ecological concerns. It includes both individual and indigenous cultures' ways and practices of interacting with the natural world. In contrast to current scientific ideas, TEK provides an alternative paradigm for tackling ecological challenges by drawing on a varied array of centuries-old local wisdom. TEK is a body of knowledge and cultural ideas passed down through generations, with a particular emphasis on the interconnection of all living beings, including people, and their surroundings.

This article urgently contributes to meeting the Sustainable Development Goals (SDGs) by tackling the growing risks to the world's oceans. It focuses on the Blue Economy principles, emphasizing the importance of balancing environmental conservation, economic growth, and sustainable development, particularly in coastal areas. The article bridges understanding gaps and coincides with the Tri Hita Karana concept, promoting environmental resilience and socio-ecological well-being through collaborative efforts at Mengiat Beach that combine traditional knowledge and sustainable practices. This collaborative effort complies with the Blue Economy principles, which emphasize the sustainable utilization of ocean resources to promote economic prosperity while simultaneously preserving the marine ecosystem and ensuring the sustainable management of ocean resources (Vierros & Fontaubert, 2017). This alignment with the Blue Economy concept is significant as it emphasizes not solely the conservation of coral ecosystems but also the broader economic advantages for local communities (Midlen, 2021). Subsequently, the combination of *Awig-Awig* and cultural values emphasizes personalized approaches for varied coastal populations, while the focus on coral reef preservation adds an important component. By combining these factors, the article presents a complete framework for accomplishing the SDGs while also promoting environmental conservation and sustainable development.

In addition, the article underlines the significance of safeguarding marine protected areas, following good governance practices, promoting sustainable tourism, and optimizing the management of waste. These activities not only help the environment, but also increase the region's international visibility and promote international tourism (Benzaken, Voyer, Poupponeau, & Hanich, 2022). Subsequently, the article discusses the potential for sustainable coastal tourism by emphasizing the appealing nature of flourishing coral reefs and pristine coastal landscapes for tourists who seek genuine and sustainable travel experiences (Senthilkumar, 2022). This article seeks to fill the gap in the literature by integrating environmental protection, economic growth, and sustainable tourism within the framework of ocean resources and coastal ecosystems, with a specific emphasis on Blue Economy concepts.

METHOD

The success of this coral reef conservation and sustainable practices effort at Mengiat Beach, Nusa Dua, Bali, hinges on multiple parameters (Figure 1). Adopting a Marine Protected Area (MPA) approach that is consistent with NOAA's (2023) definition assures the long-term preservation of marine resources, ecological functions, and cultural heritage. Coral nurseries, as found by Mellin et al. (2016), help coral reefs withstand natural disturbances. The Participatory Action Research (PAR) approach emphasizes community as the major driver of transformative change, encouraging ecological responsibility and sustainable practices. During the preparatory phase, the partnership between universities and the Bali Coastal and Marine Biodiversity Foundation lays the framework for community participation. Education that focuses on coral restoration and is consistent with the Tri Hita Karana philosophy's Parahyangan concept promotes environmental awareness and spiritual appreciation. The training highlights coral adoption methods, which are consistent with the Pawongan principle of the Tri Hita Karana philosophy, which promotes community-centered strategies. The beach clean-up action immediately addresses garbage management and environmental cleanliness challenges, hence promoting a healthy coastal habitat. The sustainable evaluation phase, inspired by Obura et al. (2019) and Edmunds & Riegl (2020), includes ongoing monitoring to fine-tune conservation measures and maintain long-term health and resilience. This complete approach, which incorporates both traditional wisdom and contemporary knowledge, is consistent with the Tri Hita Karana philosophy, which emphasizes interconnectedness, long-term well-being, and a healthy ecosystem.



Figure 1. International Collaborative Endeavor to Preserve and Conserve Coral Reefs at Mengiat Beach, Nusa Dua, Bali

The Participatory Action Research (PAR) framework is used in this international joint initiative, as this peculiar approach positions the community as the primary driver for transformative change, which resonates strongly with the initiative's goal of fostering ecological responsibility and sustainable practices (Grimwood, 2022). In these circumstances, lecturers and students of both universities are facilitators, directing a dynamic process to promote community participation in conservation initiatives. This multinational collaboration is critical for harnessing and spreading varied viewpoints and experiences, which is critical for the initiative's success in enhancing coral reef conservation and extending sustainable practices at Mengiat Beach, Nusa Dua, Bali. The methodical approach employed at Mengiat Beach to improve coral reef conservation and sustainable practices encapsulates the spirit of the Tri Hita Karana philosophy. The initiative addresses the critical issues faced by coral ecosystems while encouraging community resilience and promoting sustainable tourism by merging traditional wisdom with contemporary knowledge. This international community service program was carried out in a series of steps, which include:

Preparation

The preliminary phase marked the start of the collaborative endeavor, which was organized by the team of Faculty of Economics and Business Universitas Ngurah Rai in collaboration with the Bali Coastal and Marine Biodiversity Foundation. This interaction embodied the essence of community involvement and collaboration, matching the basic values of Mengiat Beach's coral preservation operations. The discussion at this meeting not only clarified the requirements for the upcoming activities but also detailed the framework for carrying out the Community Service projects aimed at protecting the coral reef ecosystem in Mengiat Beach, Nusa Dua. The collaboration between the University team and the Bali Coastal

and Marine Biodiversity Foundation aims to protect coral ecosystems, by undertaking coral conservation and preservation, as well as beach clean-up operations, together with the students of the University of Canberra.



Figure 2. Preliminary Meeting Between the Team of Faculty of Economics and Business UNR with Bali Coastal and Marine Biodiversity Foundation

Education

Education is one of the primary approaches applied, with the objective of imparting a full grasp of the challenges faced as well as conveying possible solutions as well as desired outcomes. Coral restoration is becoming more popular as a management option to slow the rate of coral reef degradation caused by climate change. Nonetheless, the science of coral restoration is currently heavily focused on ecological and technical factors, making it difficult to grasp how coral restoration might be used to improve reef resilience in the context of socio-ecological systems (Hein, et al., 2019). This educational strategy aligns with the Tri Hita Karana philosophy's Parahyangan principle, which promotes spiritual appreciation for nature (Qodim, 2023). The effort also resonates with the philosophy's ethos of harmonious human-nature relationships by establishing a sense of stewardship and fostering awareness among local communities and stakeholders.



Figure 3. Education Session: The Importance of Coral Conservation and Preservation

Training and Coral Adoption

According to Oppen, et al. (2017), Ecological Restoration is defined as the process of assisting in the recovery of an ecosystem that has been degraded, damaged, or destroyed, with the restored community being self-sustaining. An important element of the concept is an extensive training session focused on coral adoption and binding procedures. This initiative teaches participants how to adopt and securely attach coral fragments onto binding media, which are subsequently placed on the seabed at Mengiat Beach, as a Marine Protected Area (MPA). This hands-on training connects strongly with the Tri Hita Karana philosophy's Pawongan principle, which emphasizes harmonious social interactions and community-centered strategies (Qodim, 2023). This approach enhances the ecological integrity of the maritime

environment by encouraging people and communities to actively contribute to coral preservation, as it has been shown by Assa & Adirinekso (2022), who found that in order to prevent coral reef destruction, which has an impact on people's livelihoods, the community has carried out conservation measures in Ujung Genteng, Sukabumi, by involving diverse stakeholders. It has been shown that the community could have a role in preserving and conserving the marine environment, particularly the coral reef ecosystem, by working with associated agencies and CSR and directly with the local population.



Figure 4. Coral Adoption and Coral Placement on the Seabed of Mengiat Beach

Beach Clean-up Activity

In keeping with the main aim of coral reef protection and sustainable practices, the collaborative endeavor goes beyond education and training by actively engaging in hands-on activities. One such essential element is student participation in beach clean-up efforts along the Mengiat Beach coastline. These initiatives are intended to address the pressing issues of waste management and environmental cleanliness, demonstrating an approach to promoting a healthy coastal habitat. The involvement of students in beach clean-up activities along the Mengiat Beach shoreline demonstrates the collaboration's commitment to proactive waste management and environmental cleanliness. Students' active participation not only contributes to the immediate improvement of the coastal landscape but also the preservation of the ecosystem's delicate balance, echoing the Tri Hita Karana philosophy and the initiative's overarching goals of coral reef conservation and sustainable practices. The exchange of ideas between education institutions and coastal management can be a didactically viable way to contribute to both content acquisition and the training of student-citizens who are more conscious of their obligations as transforming, dependent, and responsible environmental agents (Araújo & Albino, 2020).



Figure 5. Clean-up Efforts Along the Mengiat Beach Coastline

Sustainable Evaluation

In the context of protecting coral reefs, it is critical to emphasize an important factor for ecological well-being, namely the critical role that coral reefs play in maintaining marine biodiversity and offering vital ecological services. Many marine species depend on coral reefs for their crucial homes. These ecosystems are recognized for their exceptional biodiversity.

The richness and diversity of marine life are supported by the protected habitat that coral formations provide. In addition, coral reefs play a major role in carbon sequestration, nitrogen cycling, and coastline protection. Given how heavily humans depend on coral ecosystems for economic activity, dietary needs, and coastline protection from natural calamities, the health and resilience of these ecosystems are critical. Consequently, monitoring coral reef state and changes is critical for improving science, management, and policy (Obura, et al., 2019). In addition, Edmunds & Riegl (2020) also stated that widespread declines in coral population have fueled a shift in motivation for reef studies and accelerated the monitoring efforts to record the changes taking place. This methodology strives to refine and improve the execution of conservation efforts by critically evaluating all stages of the activities, aligning with the philosophy's dedication to balance and harmony. This involves monitoring ongoing activities even after the formal program finishes to ensure their seamless continuation by committed partners. This proactive participation entails providing periodic updates and information on the progress and growth of the adopted coral fragments to adopters via email. This method strengthens a community commitment to the long-term health and resilience of the coral ecosystems at Mengiat Beach by establishing continuing connections and communication with participants, adopters and partners. This is consistent with the Tri Hita Karana philosophy's enduring ethos, which emphasizes interconnection and long-term well-being.



Figure 6. Progress and Growth of the Adopted Coral Fragments

RESULTS AND DISCUSSION

The conservation program includes the preservation of Marine Protected Areas (MPAs) that act as havens for coral ecosystems. A Marine Protected Area (MPA) is defined as a specified area designated and managed for the long-term conservation of marine resources, ecological services, and cultural heritage (NOAA, 2023). Coral propagation is a significant approach used within these specified zones. MPAs that are well-managed and enforced have the potential to expand or sustain the diversity and function of the protected coral reef, with some of the benefits extending to adjacent non-protected reefs (Bonaldo, Pires, Junior, Hoey, & Hay, 2017). Coral nurseries are built to house coral fragments that are nourished and propagated to restore and improve the health of the reef. This strategy is consistent with previous research by Mellin, MacNeil, Cheal, Emslie, & Caley (2016) demonstrating the MPAs can boost coral reef populations' resilience to natural disturbances such as coral bleaching, coral diseases, and storms. Furthermore, these MPAs help to maintain biodiversity and healthy fish populations (Rojo, Sánchez-Meca, & García-Charton, 2019).

A variety of coral species, including but not limited to *Acropora*, *Porites*, and *Pocillopora* species are carefully cultivated at the coral nurseries at Mengiat Beach. These species have been chosen due to their ecological significance and degree of environmental adaptation. Coral survival points are established by a rigorous assessment process that takes into account variables including temperature, nutrition availability, and water quality. Although the exact numbers for survival points might change based on the type of coral and the local environment, the assessment guarantees that the cultured corals are hardy and suitable to prosper in Mengiat Beach's maritime environment.

Subsequently, community engagement spans an ongoing timeframe, with activities strategically organized throughout the year to maintain sustained interest and commitment. Evaluation data from community activities are critical in determining the effectiveness and sustainability of Mengiat Beach's coral reef conservation initiative. The community's participation in these events is evaluated using a combined approach that includes both quantitative and qualitative parameters. Quantitative measures track the frequency and duration of community participation in coral adoption, training sessions, and beach clean-ups. These measurements provide real information about the level of active

participation and commitment over time. Furthermore, qualitative assessments include interviews to acquire information about the community's impression of the program's impact, understanding of environmental issues, and perceived long-term advantages of their participation.

The Mengiat Beach collaborative effort to improve coral reef conservation and sustainable practices has incorporated innovative approaches, such as the Mars Assisted Restoration System (MARRS). Reef Stars were brought in as an approach for regenerating coral ecosystems in this innovative approach to coral preservation. MARRS embodies a holistic approach to coral preservation, providing an environment conducive to thriving reef ecosystems. It is rooted in both the Tri Hita Karana philosophy and contemporary conservation approaches. MARRS, or Mars Assisted Restoration System, is a breakthrough coral restoration system that has shown encouraging results. The deployment of Reef Stars, hexagonal sand-coated steel structures studded with connected coral bits, lies at the core of it. These structures were deliberately set up to cross barren coral rubble fields and bridge the gaps between the reef's remaining living coral. The collaborative endeavor at Mengiat Beach has tapped into an innovative methodology that connects seamlessly with the Tri Hita Karana philosophy concepts by embracing MARRS.

The Reef Stars, which function as a foundation for coral fragment attachment, demonstrate the initiative's approach to increasing local engagement and shared responsibility. The placement of these structures not only promotes coral restoration but also provides for the overall health of the marine ecosystem. Furthermore, the use of Reef Stars demonstrates the incorporation of sustainable techniques, which corresponds to the philosophy's emphasis on balance and equilibrium. These constructions are basic and cost-effective, demonstrating MARRS's pragmatic approach. This strategy is consistent with the Palemahan principle of the Tri Hita Karana philosophy, which calls for responsible resource management (Qodim, 2023). The utilization of MARRS also fits in with the greater objectives of the joint endeavor.



Figure 7. The Reef Star of MARRS (Mars Assisted Restoration System)

One of the pivotal achievements of the initiative centered on coral reef conservation and sustainable practices at Mengiat Beach is the donation of ten dozen Reef Stars by the Faculty of Economics and Business Universitas Ngurah Rai and the University of Canberra to the Bali Coastal and Marine Biodiversity Foundation. This donation exemplifies these academic institutions' dedication to preserving coral ecosystems and demonstrating their commitment to actively participating in environmental conservation. Aside from its financial worth, this donation is an investment in the well-being of the marine habitat at Mengiat Beach. The academic institutions, working alongside the Bali Coastal and Marine Biodiversity Foundation, emphasize their shared commitment to reviving and preserving coral reefs for the benefit of current and future generations. This collaborative atmosphere displays a dedication to environmental well-being and long-term harmony.



Figure 8. Symbolic Handover of Donations in the form of Reef Stars

Reef Stars represent a shared commitment to coral preservation that goes beyond a simple contribution. It exemplifies the integration of creative solutions with the conservation mission. These structures not only maintain the possibility of recovering coral populations but also represent the commitment of a wide range of stakeholders to the long-term health of Mengiat Beach's marine ecology. The donation of Reef Stars to the Bali Coastal and Marine Biodiversity Foundation by the Faculty of Economics and Business Universitas Ngurah Rai and the University of Canberra is an outstanding demonstration of collaboration and dedication. It is consistent with the initiative's overarching goals of coral reef conservation and long-term practices at Mengiat Beach. As these Reef Stars settle into the embrace of the ocean, they reflect not just a physical presence but also a legacy of devotion to coral preservation, symbolizing a common purpose to maintain environmental well-being and build long-term ecological balance.

CONCLUSION

The combined effort at Mengiat Beach to improve coral reef conservation and sustainable practices has produced extraordinary results, integrating traditional wisdom with current approaches in the context of the Tri Hita Karana philosophy. This multifaceted initiative, coordinated by the Faculty of Economics and Business at Universitas Ngurah Rai and the University of Canberra in collaboration with the Bali Coastal and Marine Biodiversity Foundation, demonstrates a comprehensive commitment to environmental resilience and community empowerment.

The preliminary phase laid the groundwork for the succeeding activities, emphasizing the importance of collaboration and community involvement. The coordinated activities of the University team and the Bali Coastal and Marine Biodiversity Foundation laid the groundwork for proactive conservation methods. The donation of Reef Stars to the foundation by the Faculty of Economics and Business Universitas Ngurah Rai and the University of Canberra represents a tangible commitment to coral preservation, mirroring the principle of responsible resource management in the Tri Hita Karana philosophy. The incorporation of an in-depth education session, in which participants learned how to adopt and securely attach coral fragments to binding material, was fundamental to the project. This session prepared participants to actively contribute to coral preservation initiatives. The initiative's educational approach promotes awareness and comprehension among local communities and stakeholders. The initiative fosters an atmosphere of environmental care among participants through teaching knowledge, which resonates deeply with the Tri Hita Karana philosophy's precepts.

The combination of academic institutions' collaboration and community participation illustrates the initiative's all-encompassing nature. Students led cleanup activities that highlighted the necessity of waste management in sustaining the health of coastal ecosystems. These activities are consistent with the Tri Hita Karana philosophy, which promotes community solidarity and a sense of shared responsibility. In addition, continuing monitoring and periodic updates offer

participants and partners information about the growth and progress of the adopted coral fragments. This ongoing involvement is consistent with the Tri Hita Karana philosophy's emphasis on interconnection and long-term well-being.

The program adheres to the ideas of the Tri Hita Karana philosophy by combining traditional wisdom with contemporary methods. This initiative not only revitalizes coral ecosystems but also cultivates a permanent legacy of environmental stewardship and overall well-being through collaborations, training, education, and community engagement.

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REFERENCES

- Adnyani, N. K., & Purnamawati, I. G. (2020). Tri Hita Karana and tourism village management models for wellbeing. *Target; Jurnal manajemen dan Bisnis*, 2(2), 157-166. doi:<https://doi.org/10.30812/target.v2i2.750>
- Araújo, R., & Albino, J. (2020). Assentment of Interest of students and teachers in coastal aspects: The star of a coastal management change. *Revista Costas*, 2(2), 73-86. doi:<https://doi.org/10.26359/COSTAS.1002>
- Assa, A., & Adirinekso, G. (2022). The role of community in the maintenance and preservation of coral reefs in Ujung Genteng, Sukabumi. *Jurnal Manajemen Indonesia*, 22(2), 183-188. doi:<https://doi.org/10.25124/jmi.v22i2.3960>
- Astuti, N., Ginaya, G., & Susyarini, N. (2019). Designing Bali tourism model through the implementation of Tri Hita Karana and Sad Kertih values. *International Journal of Linguistics, Literature and Culture*, 5(1), 12-23. doi:<https://doi.org/10.21744/IJLLC.V5N1.461>
- BAPPENAS. (2021). *Blue economy: Development framework for Indonesia's economic transformation*. (L. Sambodo, S. Yanti, D. Pane, & A. Sim, Eds.) Jakarta: Ministry of National Development Planning / National Development Agency (BAPPENAS).
- Benzaken, D., Voyer, M., Pouponneau, A., & Hanich, Q. (2022). Good governance for sustainable blue economy in small islands: Lessons learned from the seychelles experience. *Frontiers in Political Science*, 4, 1-23. doi:<https://doi.org/10.3389/fpos.2022.1040318>
- Biermann, F., Kanie, N., & Kim, R. E. (2017). Global governance by goal-setting: The novel approach of the UN sustainable development goals. *Current Opinion in Environmental Sustainability*, 26-31. doi:<http://dx.doi.org/10.1016/j.cosust.2017.01.010>
- Boakes, Z., Mahyuni, L., Stafford, R., & Cvitanovic, M. (2022). Community perceptions of coral reef conservation in a rural fishing Village in North Bali, Indonesia. *Research Square*, 1-27. doi:<https://doi.org/10.21203/rs.3.rs-1374792/v1>
- Bonaldo, R., Pires, M., Junior, P., Hoey, A., & Hay, M. (2017). Small marine protected areas in Fiji provide refuge for reef fish assemblages, feeding groups, and corals. *PLOS ONE*, 1-26. doi:<https://doi.org/10.1371/journal.pone.0170638>
- Boström-Einarsson, L., babcock, R., Bayraktarov, E., Ceccarelli, D. C., Ferse, S. H., Harrison, P., . . . McLeod, M. (2020). Coral restoration – A systematic review of current methods, successes, failures and future directions. *PLOS ONE*, 15(1). doi:<https://doi.org/10.1371/journal.pone.0226631>
- Edmunds, P., & Riegl, B. (2020). Urgent need for coral demography in a world where corals are disappearing. *Marine Ecology Progress Series*, 635, 233-242. doi:<https://doi.org/10.3354/meps13205>
- Elegbede, I. O., Akintola, S. L., Jimoh, A., & Jolaosho, T. L. (2023). Blue economy (Sustainability). In S. O. Idowu, *Encyclopedia of Sustainable Management* (pp. 1-9). Switzerland: Springer Nature. doi:http://dx.doi.org/10.1007/978-3-030-02006-4_401-1
- Estradivari, Agung, M. F., Adhuri, D. S., Ferse, S. C., Sualia, I., Brown, A. A., . . . Ahmadia, G. N. (2022). Marine conservation beyond MPAs: Towards the recognition of other effective area-based conservation measures (OECMs) in Indonesia. *Marine Policy*, 137, 1-12. doi:<https://doi.org/10.1016/j.marpol.2021.104939>
- Gómez-Baggethun, E., Corbera, E., & Reyes-García, V. (2013). Traditional ecological knowledge and global environmental change: research findings and policy implications. *Ecology & Society*, 18(4). doi:<https://doi.org/10.5751/ES-06288-180472>
- Grimwood, B. (2022). *Participatory action research - Democratizing knowledge for social justice* (2 ed.). (C. Johnson, & D. Parry, Eds.) Routledge.

- Hadiyanto, H. (2022). "Tri hita Karana" life ideology as a cultural identity of Balinese society reflected in elizabeth gilbert's eat pray love (anthropological approach in literature). *The 7th International Conference on Energy, Environment, Epidemiology and Information System (ICENIS 2022)* (pp. 1-5). EDP Sciences. doi:<https://doi.org/10.1051/e3sconf/202235902026>
- Hein, M., Birtles, A., Willis, B., Gardiner, N., Beeden, R., & Marshall, N. (2019). Coral restoration: Socio-ecological perspectives of benefits and limitations. *Biological Conservation*, 14-25. doi:<https://doi.org/10.1016/J.BIOCON.2018.11.014>
- Hughes, T., Anderson, K., Connolly, S., Heron, S., Kerry, J., Lough, J., . . . Pandolfi, J. (2018). Spatial and temporal patterns of mass bleaching of corals in the Anthropocene. *Science*, 359, 80-83. doi:<https://doi.org/10.1126/science.aan8048>
- Kuhn, R., & Duerden, F. (2021). A review of traditional environmental knowledge: An INTERDISCIPLINARY CANADIAN PERSPECTIVE. *Culture*, 16(1), 71-84. doi:<https://doi.org/10.7202/1084104ar>
- Mellin, C., MacNeil, M., Cheal, A., Emslie, M., & Caley, M. (2016). Marine protected areas increase resilience among coral reef communities. *Ecology Letters*, 19(6), 629-637. doi:<https://doi.org/10.1111/ele.12598>
- Midlen, A. (2021). What is the blue economy? A spatialised governmentality perspective. *Maritime Studies*, 20, 423-448. doi:<https://doi.org/10.1007/s40152-021-00240-3>
- NOOA. (2023). *What is a marine protected area (MPA)?* Retrieved 2023, from NOAA Ocean Exploration: <https://oceanexplorer.noaa.gov/facts/mpas.html>
- Obura, D., Aeby, G., Amorntthamarong, N., Appeltans, W., Bax, N., Bishop, J., . . . Wongbusarakum, S. (2019). Coral reef monitoring, reef assessment technologies, and ecosystem-based management. *Frontiers in Marine Science*, 6(580), 1-21. doi:<https://doi.org/10.3389/fmars.2019.00580>
- Oppen, M., Gates, R., Blackall, L., Cantin, N., Chakravarti, L., Chan, W., . . . Putnam, H. (2017). Shifting paradigms in restoration of the world's coral reefs. *Global Change Biology*, 23(9), 3437-3448. doi:<https://doi.org/10.1111/gcb.13647>
- Qodim, H. (2023). Nature harmony and local wisdom: Exploring Tri Hita Karana and traditional ecological knowledge of the Bali aga community in environmental protection. *Religious: Jurnal Studi Agama-Agama dan Lintas Budaya*, 7(1), 1-10. doi:<https://doi.org/10.15575/rjsalb.v7i1.24250>
- Rojo, I., Sánchez-Meca, J., & García-Charton, J. (2019). Small-sized and well-enforced marine protected areas provide ecological benefits for piscivorous fish populations worldwide. *Marine Environmental Research*, 149, 100-110. doi:<https://doi.org/10.1016/j.marenvres.2019.06.005>
- Senthilkumar, R. (2022). Sustainable coastal tourism- An overview. *SAFER - Sustainability, Agri, Food and Environmental Research*, 10, 1-10. doi:<https://doi.org/10.7770/safer-v10n1-art2497>
- Suamba, I., & Utama, K. (2017). Materiality and spirituality in Bali tourism: An ethical reflection on the Tri Hita Karana. *IJASTE – International Journal of Applied Sciences in Tourism and Events*, 1(1), 82-93. doi:<https://dx.doi.org/10.31940/ijaste.v1i1.189>
- Trialfhianty, T. I., & Suadi. (2017). The role of the community in supporting coral reef restoration in Pemuteran, Bali, Indonesia. *Journal of Coastal Conservation*, 873-882. doi:<https://doi.org/10.1007/s11852-017-0553-1>
- United Nations. (2018). *The 2030 agenda and the sustainable development goals: An opportunity for Latin America and the Caribbean*. Santiago: United Nations Publication. Retrieved from <https://repositorio.cepal.org/server/api/core/bitstreams/6321b2b2-71c3-4c88-b411-32dc215dac3b/content>
- Vierros, M., & Fontaubert, C. D. (2017). *The potential of the blue economy: Increasing long-term benefits of the sustainable use of marine resources for small island developing states and coastal least developed countries*. Washington DC: International Bank for Reconstruction and Development/The World Bank. Retrieved 2023, from https://www.climateaction.org/images/uploads/documents/World_Bank.pdf
- Yasa, P. D. (2022). Tri Hita Karana (Sekilas historis dan hakikat keharmonisan semesta). *Sphatika: Jurnal Teologi*, 13(2), 205-216. doi:<https://doi.org/10.25078/sphatika.v13i2.2214>
- Yonvitner, Agus, S., Lestari, D., Pasaribu, R., Supriyanto, E., Widodo, C., . . . Akmal, S. (2022). Vulnerability status of the coral ecosystem in Kepulauan Seribu Marine National Park, Indonesia. *Coastal management*, 50(3). doi:<https://doi.org/10.1080/08920753.2022.2037388>
- Yulianingsih, w., Indawati, Y., & Kartika, A. W. (2021). Awig-Awig as traditional law written in traditional law perspective in Indonesia. *5th International Seminar of Research Month 2020. 2021*, pp. 189-194. NST Proceedings. doi:<http://dx.doi.org/10.11594/nstp.2021.0929>