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Integrated Conservation Edu-Tourism (ICET) Model: An ergonomic SHIP approaches

Lilik Sudiajeng [a]
Ni Made Ernawati [b]
Putu Astawa [c]
Ketut Widnyana [d]
Ni Kadek Sri Ebtha Yuni [e]
I Ketut Gde Juli Suarbawa [f]
M. Yusuf [g]

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Abstract

Background: Environmental degradation, particularly the global groundwater crisis, necessitates a fundamental shift in human behaviour towards a more sustainable resource management. **Objective:** This study aims to design and evaluate an Integrated Conservation Edu-tourism (ICET) model in Sulangai Tourism Village, Bali, focusing on bridging the gap between technical conservation and experiential tourism. **Methodology:** The model was developed using the Ergonomics SHIP (Systemic, Holistic, Interdisciplinary, and Participatory) approach. This action research integrated technical infrastructure strengthening, such as Rainwater Harvesting (RWH) recharge wells, with human capital development through training and mentoring. The performance was measured using a pre-test and post-test framework to assess changes in community competency and awareness. **Results:** The SWOT analysis positioned the project in the "Aggressive Zone," indicating strong potential for growth-oriented strategies. Post-intervention results showed a significant increase in technical competency, particularly in water conservation and waste management, where technical skills surged by 15.17%; furthermore, 83.90% of participants expressed readiness to serve as Disaster Response Village Squads. **Conclusion:** The ICET model effectively transforms the delivery of passive tourists experience into active conservation participation, empowering local communities in managing the ICET, and become competent environmental stewards. This approach provides a scalable blueprint for sustainable rural tourism.

[a] Politeknik Negeri Bali, Badung, Indonesia
[b] Politeknik Negeri Bali, Badung, Indonesia
[c] Politeknik Negeri Bali, Badung, Indonesia
[d] Universitas Mahasaraswati Denpasar, Denpasar, Indonesia
[e] Politeknik Negeri Bali, Badung, Indonesia
[f] Politeknik Negeri Bali, Badung, Indonesia
[g] Politeknik Negeri Bali, Badung, Indonesia

Corresponding author:
Lilik Sudiajeng,
Politeknik Negeri Bali, Badung, Indonesia.
Email address: sudiajeng@pnb.ac.id

1 Introduction

Over the past few decades, environmental degradation, specifically the global groundwater crisis has become a pivotal topic at international forums, including the World Water Forum (WWF). This crisis stems primarily from overexploitation, poor governance, and unsustainable management practices. In many developing regions, such as Pakistan, groundwater depletion is inextricably linked to policies favouring agricultural expansion and economic development at the expense of sustainable resource management (Nabeel, 2021). Similarly, Southeast Asian nations, including Indonesia, face immense pressure from rapid population growth and urbanization. A World Bank report highlights the severity of this issue in Indonesia, where approximately 80% of the population lacks access to piped clean water, forcing reliance on artesian wells (35%) and other sources (Arshad, 2016). Recent studies highlight that Indonesia still faces a severe clean water deficit, where only roughly 20-30% of the population has access to piped water, while the majority relies on groundwater extraction which is increasingly vulnerable to climate change impacts (Putri et al., 2023; World Bank, 2021). This trend mirrors the critical situation in India, where 27 of 31 major aquifers are being depleted faster than their recharge rates due to climate change and anthropogenic pressures (Nidhi & Karant, 2025).

Beyond availability, groundwater quality is a pressing concern. While groundwater is generally more resilient to climate change than surface water, reduced aquifer recharge and increased pollution are altering its chemical composition. Research indicates shifts in calcium, magnesium, and sulphate ratios, which affect water hardness and have serious public health implications, including cardiovascular risks and growth retardation (Barbieri et al., 2023). Addressing this crisis requires more than technical solutions; it demands a fundamental shift in human behaviour.

In response to these challenges, the 10th World Water Forum in Bali (2024) emphasized "returning to nature" and "strengthening water-saving behaviour" as flagship programs. Human behaviour, however, is complex and influenced by beliefs, culture, and education. To effectively alter environmental behaviour, educators must understand individual motivations. Recent studies suggest that **experiential learning**—providing direct, hands-on experience—is one of the most effective methods for fostering behavioural change. When individuals are actively involved in conservation activities, they develop a stronger emotional connection and sense of responsibility (Shutaleva, 2023).

This correlation is supported by neuroscience and management studies. For instance, Jocelyn et al. (2010), found a strong link between physiological perception and emotional processing, while Pellissier (2013), demonstrated that experience is a strong predictor of awareness and the adoption of new practices. In the context of rural development, Gao & Wu (2017), argue that revitalizing traditional villages requires integrating local resources with visitor experiences to create high-quality tourism products. Furthermore, Purnomo et al. (2021), emphasize that sustainable tourism villages must empower local communities to transform environmental awareness into active conservation practices.

Inspired by these findings, this study proposes a **Conservation Edu-tourism (CET) Model** to support groundwater conservation. Unlike conventional tourism, this model offers tour packages based on local potential—cultural, agricultural, and natural—where tourists unconsciously engage in conservation efforts while enjoying their visit. The model is designed using the **Ergonomics SHIP Approach** (Systemic, Holistic, Interdisciplinary, and Participatory). The primary objective is to develop a sustainable destination model that harmonizes visitor satisfaction with the preservation of Sulangai Village's natural and cultural heritage.

2 Materials and Methods

This study is action research, wherein intervention is deployed to the research participants and the involved entities with the aim of addressing a specific problem or improving a particular situation; the outcomes are evaluated to inform future actions and drive positive change. The research stages are presented in the following.

Measuring the Potency

The design of the Conservation Edu-tourism (CET) model was developed through a case study in Sulangai Tourism Village, Badung Regency, Bali Province. The research began with a preliminary study to identify the village's internal strengths and weaknesses, as well as external opportunities and challenges.

To validate these initial findings, a Focus Group Discussion (FGD) was conducted involving key stakeholders: village leadership, religious figures, the tourism awareness group (Pokdarwis), farmers, and youth representatives. The data were analyzed using SWOT Analysis (Strengths, Weaknesses, Opportunities, Threats). Utilizing Applying SWOT in to the post-pandemic era is crucial for identifying adaptive strategies that align community capability with the new market demands (Santoso et al, 2022). The goal of this analysis was to formulate strategies that maximize organizational strengths and opportunities while mitigating weaknesses and threats. Key aspects evaluated included: 1) Natural resources; 2) Agricultural and plantation potential; 3) Local wisdom and religious practices; 4) Cultural assets; 5) Human resources; and 6) Institutional capacity.

The Ergonomics SHIP Approach

The conceptual framework for the ICET Development model is the **Ergonomics SHIP Approach** (Systemic, Holistic, Interdisciplinary, and Participatory).

- **Systemic:** The program is viewed as a unified system where solutions in one sub-system must not create negative externalities in others.
- **Holistic:** Planning covers the entire lifecycle, from preparation to implementation.
- **Interdisciplinary:** The design integrates insights from engineering, economics, ergonomics, and environmental science.
- **Participatory:** Strategic management in tourism requires a collaborative approach involving government, academia, business, and community to ensure the model is practically viable and socially accepted (Sudiajeng et al., 2018; Bovsh et al., 2023).

This approach ensures a comprehensive design process (Figure 1):

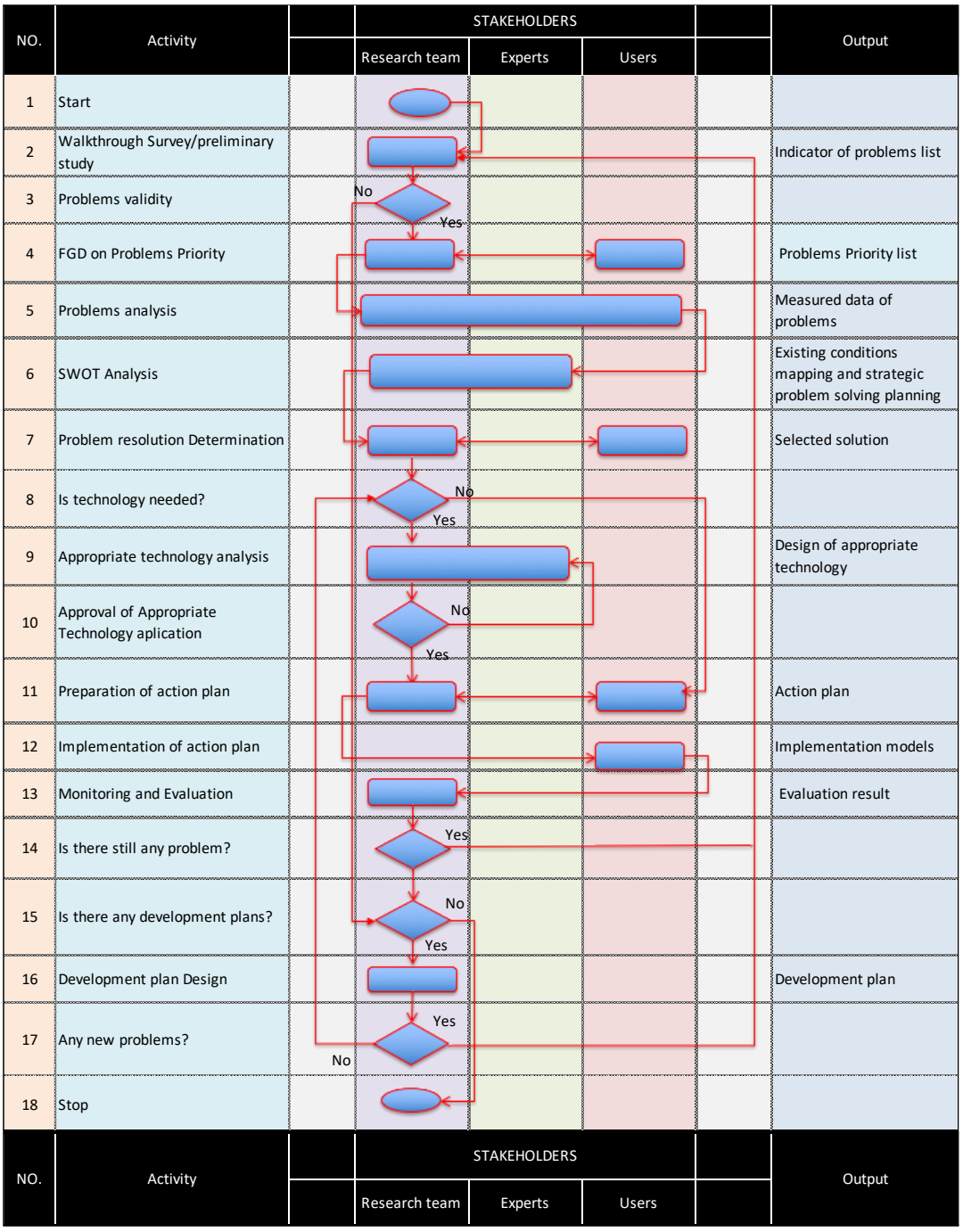

Figure 1. Ergonomics SHIP Approach

Case Study and Performance Measurement

To evaluate the efficacy of the proposed **Integrated Conservation Edu-tourism (ICET)** model, a simulation was conducted in Sulangai Village. The participants included foreign university students (partners of Bali State Polytechnic), active local students, and 30 residents of Sulangai Village. Performance was measured using a pre-test and post-test questionnaire design to assess changes in environmental awareness and satisfaction before and after the

simulation. The results of this performance measurement will serve as the basis for a subsequent FGD with tourism experts and community leaders to refine and finalize the ICET model design. The complete research flowchart is presented in **Figure 2**

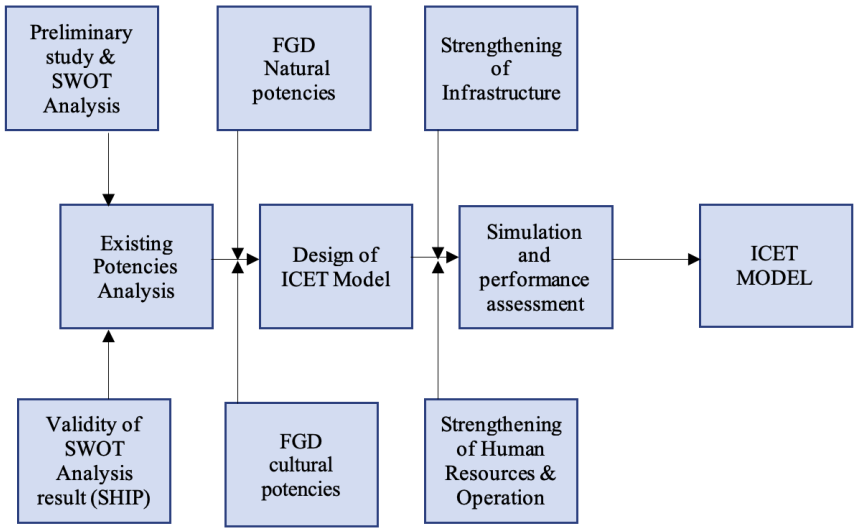

Figure 2. Research flowchart

3 Results and Discussions

3.1 Existing Potencies Analysis

The results of the preliminary study, followed up with focus group discussions (FGDs) was conducted through Ergonomics SHIP approach. There were 6 parties which involved included: 1) Village Government; 2) Traditional Village Officers; 3) Religious Leaders; 4) Farmer Community Groups; 5) Tourism Community Groups; 6) Youth Community, are presented in Table 1 below.

Table 1
Data from the preliminary study and FGD on the existing conditions of Sulangai Village

STRENGTH (S)	Weight	Average Rating	Average Weight Score
NATURAL RESOURCES: Potential natural resources through indicators of cool, clean, beautiful, healthy, sustainable air as well as potential rainfall and high-water absorption areas.	0.20	4	0.800
PLANTATION, AGRICULTURE AND LIVESTOCK POTENTIAL: The land area dominated by large plantations and agriculture with rice, fruit and vegetable crops.	0.20	3.67	0.733
RELIGIOUS POTENTIAL: Kancing Gumi Temple, place of purification	0.20	4.00	0.80
HUMAN RESOURCE POTENTIAL: Has a population of quite high productive age with the main livelihood as farmers or farm workers	0.15	2.83	0.425
CULTURAL POTENTIAL: Has a unique culture that other regions do not have	0.10	3.67	0.367

STRENGTH (S)	Weight	Average Rating	Average Weight Score
INSTITUTIONS: Has a relatively complete institutional structure and elements, including civil service, customary, professional and community institutions.	0.15	4.00	0.600
TOTAL AVERAGE WEIGHT SCORE OF STRENTH (S)			3.725
WEEKNESSES (W)	Weight	Average Rating	Average Weight Score
NATURAL RESOURCES: Natural resource protection programs are still weak and unstructured	0.20	2.67	0.533
PLANTATION, AGRICULTURE, AND LIVESTOCK POTENTIAL: Management, marketing, and image systems are inadequate	0.20	3.00	0.600
RELIGIOUS POTENTIAL: Not yet optimally developed as a religious tourism destination	0.10	3.167	0.317
HUMAN RESOURCE POTENTIAL: Educational background, entrepreneurial ability and willingness, understanding and intelligent use of technology still need to be improved.	0.15	4.00	0.600
INSTITUTION: Tourism Community Groups which does not yet have the strength of legal aspects, requires strong management.	0.15	2	0.300
SARPRAS: Public facilities and infrastructure such as road access, public transportation, banking facilities, internet access are still inadequate	0.10	2.333	0.233
TOTAL AVERAGE WEIGHT SCORE OF WEEKNESSES (W)			2.900
OPPORTUNITY (O)	Weight	Average Rating	Average Weight Score
Attention and various government programs for environmentally friendly tourist villages	0.30	4	1.20
Attention and various government programs for MSMEs and the creative industry	0.25	4	1.00
Back to nature tourism trends, religious tourism, health and wellness/mindfulness tourism	0.25	4	1.00
Industry 4.0 era	0.20	4	0.80
TOTAL AVERAGE WEIGHT SCORE OF OPPORTUNITY (W)			4.00
THREAT (T)	Weight	Average Rating	Average Weight Score
Landslide disaster	0.40	3.167	1.267
The presence of investors who care less about the environment	0.30	1.500	0.450
Tourist awareness of protecting the environment is still low	0.15	1.667	0.250
Tourists' awareness for environmental preservation is low (plastic waste)	0.15	2.00	0.300
TOTAL AVERAGE WEIGHT SCORE OF THREAT (T)			2.667
IFAS = (S-W)/2			**0.513**
EFAS = (O-T)/2			**0.867**

Based on the Internal Factor Analysis Summary (IFAS) or internal strength and External Factor Analysis Summary (EFAS) or external strength places Desa Sulangai's Edu-tourism project squarely in **Quadrant I** (X=+0.513 and

Y=+0.867). This position is defined as the **Aggressive Zone**. It indicates that the organization (Desa Sulangai) is in an excellent position to use its internal strengths to take advantage of external trends (David, 2011; Galdavi et al., 2024).

A positive score on the X-axis suggests that **Strengths > Weaknesses**. This indicates that Sulangai village possesses significant internal resources that outweigh its current limitations/weaknesses. The village has a strong internal capacity to support the proposed Edu-tourism development. According to Reihanian et al. (2012), in the context of ecotourism, a positive internal factor score implies that the destination has the necessary "carrying capacity" and resource base to sustain tourism activities without immediate degradation.

A highly positive score on the Y-axis suggests that **Opportunities > Threats**. The external environment is highly favourable. This likely reflects the growing global trend for sustainable tourism, government support for "Desa Wisata" (tourism villages), or increasing demand for nature-based education. The magnitude of this score (0.867) being higher than the IFAS score suggests that the external "pull" is currently stronger than the village's internal "push." Abya et al. (2015), suggest that a high EFAS score highlights a "window of opportunity" where market demand is robust, and external risks (such as competition or regulatory changes) are minimal or manageable.

Since the project falls into Quadrant I, the recommended direction is the **Growth Oriented Strategy** (Goranczewski & Puciato, 2010). The focus should be on mobilizing internal strength to capture external opportunities.

In the context of rural tourism planning, the SWOT analysis serves as a critical diagnostic tool. The results for Desa Sulangai (IFAS=0.513, EFAS=0.867) demonstrate a **competitive advantage**. Recent studies in sustainable tourism suggest that destinations in this position should avoid "complacency." Galdavi et al. (2024), note that while Quadrant I represents an ideal state, it requires rapid implementation of infrastructure to meet the anticipated demand characterized by the high EFAS score. Furthermore, Abya et al. (2015), highlight that for community-based tourism, this "Aggressive" strategy must be balanced with community capacity building to ensure that the growth does not overwhelm the local social structure.

Therefore, the development of the Integrated Conservation Edu-Tourism should not be tentative. The data supports a rapid expansion strategy, prioritizing the construction of educational facilities and the formalization of tourism management bodies to capture the existing external momentum.

3.2 Design of Integrated Conservation Edu-Tourism (ICET) Model

The core product of the ICET model is the "One Day Tour" package. This package is designed to integrate cultural immersion, disaster mitigation education, and practical conservation actions into a seamless visitor journey. The tour flow consists of six distinct stages with considered the local genuine Tri Hita Karana which consist of three foundational philosophy of Balinese Hinduism, meaning "three causes of well-being," focusing on achieving harmony in three key relationships: Parhyangan (harmony with God), Pawongan (harmony among people), and Palemahan (harmony with nature/environment) (as illustrated in Figure 3).

1) Stage 1: Cultural Immersion (Pawongan).
   Tourists are welcomed with a traditional Balinese ceremony (flower draping). This authentic welcome acts as a critical "ice-breaker" that increases tourists' emotional attachment to the destination (Sthapit et al, 2023).
2) Stage 2: Cognitive Engagement.
   Tourists watch an educational video on disaster mitigation at the Learning Center. Research highlights that visual-based storytelling effectively increases risk awareness without reducing trip enjoyment (Rindarsih et al, 2021).
3) Stage 3: Experiential Learning (Palemahan).
   Visitors interact directly with the Rainwater Harvesting Wells and Conservation Garden. This stage applies *Experiential Learning Theory*, where direct interaction with nature triggers pro-environmental behaviour (Sul et al., 2021).
4) Stage 4: Gastronomy & Relaxation.
   Lunch is served at the "Honey Cottage" (*Pondok Madu*), featuring local cuisine. Gastronomy tourism supports local SMEs and enhances the "Memorable Tourism Experience" through sensory engagement (Putra, 2019).
5) Stage 5: Thematic Exploration.
   Tourists choose a sub-destination based on interest (Nature, Religion, or Agro-tourism). This customization addresses the modern traveler's demand for personalized experiences (Rasoolimanesh et al., 2021).

6) Stage 6: Spiritual Reflection (Parahyangan).

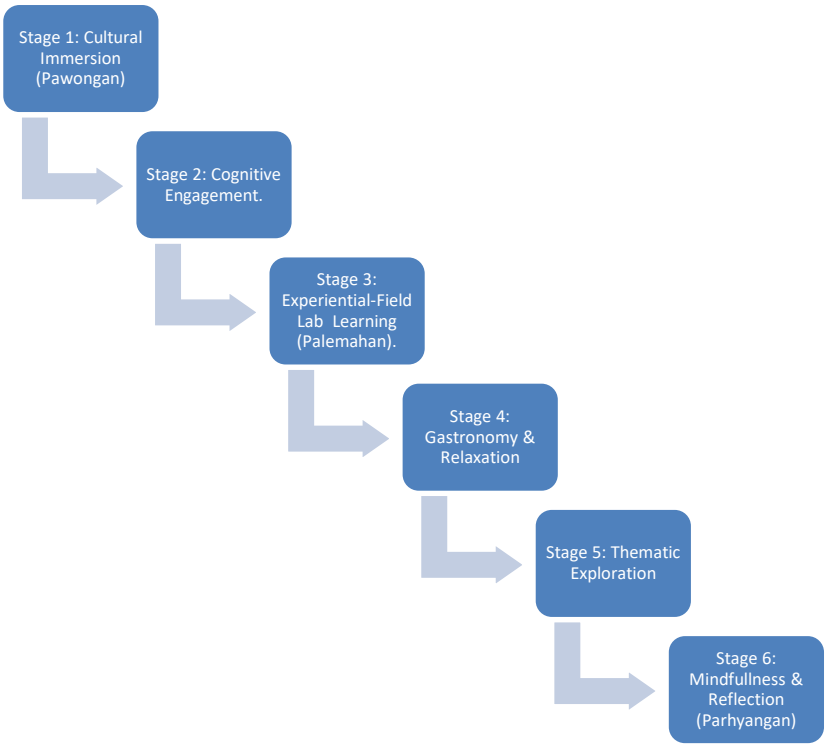

Figure 3. The one day tour flow of Conservation Edu-tourism

The tour concludes with prayer, catering to the rising trend of wellness and spiritual tourism in the post-pandemic era (Dillette et al, 2021).

This Integrated Conservation Edu-Tourism (ICET) model serves as a **transformative platform** that goes beyond conventional recreational travel. By systematically integrating practical conservation demonstration (Rainwater Harvesting Wells) with deep cultural and spiritual elements (Balinese welcome and Joint Prayer), the package inherently adheres to the local philosophical principle of ***Tri Hita Karana*** (Sukarma, 2016). The core proposition ensures tourists are not merely observers, but active participants who gain hands-on experience in **environmental, cultural, and spiritual conservation**. It is anticipated that this holistic, experiential approach will foster high levels of awareness and personal commitment, ultimately motivating visitors to actively participate in and contribute to long-term conservation programs in their daily lives, thereby maximizing the socio-environmental impact of the Sulangai Tourism Village.

3.3 Simulation and performance assessment

Strengthening Infrastructure: The Field Laboratory For Water Conservation

In the "Integrated Conservation Edu-tourism" model, infrastructure is elevated from a passive utility to an active pedagogical tool. According to Walker & Moscardo (2014), sustainable tourism should go beyond the visitor experience by enacting shared value transformations; in this context, the infrastructure acts as a medium for environmental advocacy. This transformation is increasingly vital as water scarcity becomes a global threat. As highlighted by Yanopoulos et al. (2020), rainwater harvesting (RWH) is a crucial tool to confront water scarcity worldwide, offering a sustainable method to supplement surface and groundwater resources in areas with inadequate supply. By establishing a field laboratory that integrates these systems, the destination provides a hands-on learning environment where tourists can witness the practical synergy between engineering and biology.

A. Rainwater Harvesting Wells (4 Units)

The construction of four units of Rainwater Harvesting Wells (**Recharge Wells)** serves as the technical backbone of the site's "Ecodrainage" system. As highlighted by Suripin (2004), sustainable drainage systems aim not only to manage runoff but also to restore the natural hydrological cycle. These units facilitate **Artificial Recharge**, channelling rainwater directly into the aquifers.

This intervention is a critical response to global water scarcity. Campisano et al. (2017), emphasize that rainwater harvesting (RWH) systems are essential contemporary tools for water management, especially in areas where traditional water sources are under stress. For tourists, these wells serve as a live demonstration of climate change adaptation, showing how to mitigate land subsidence and maintain the local water table.

B. Miniature Conservation Park (Vegetative Conservation)

Complementing the mechanical approach of the wells, the **Miniature Conservation Park** functions as a biological "living sponge." This approach follows the principles of vegetative conservation discussed by Arsyad (2010), where specific plants are utilized to improve soil structure and increase the soil's capacity to absorb water.

The park features species with specialized root systems, such as *Vetiveria zizanioides* or indigenous deep-rooted trees. These plants create "macropores" that enhance the soil's infiltration rate. According to Morgan (2009), maintaining such vegetative cover is the most effective long-term strategy for soil erosion control and water retention. In the edu-tourism package, this park serves as a "silent guide," fulfilling the role of **Environmental Interpretation** (Tilden, 1957/2007) by transforming complex biological processes into an observable and engaging tourist attraction.

Strengthening of Human capital and Operational Management

The success of an Integrated Conservation Edu-tourism model relies heavily on the readiness of the host community and the efficiency of its operational management. To ensure the sustainability of the project, a comprehensive capacity-building program—consisting of specialized training, simulations, and intensive mentoring—was implemented.

A. Capacity Building and Skill Transformation

Training programs were designed to transform local staff into "Eco-Interpreters." This approach aligns with the findings of Wolf et al. (2017), who argue that the quality of tour guiding is a primary driver of visitor satisfaction and environmental awareness. Furthermore, as emphasized by Adiyoso & Kanegae (2012), community-based education and active participation are fundamental in fostering long-term resilience and ensuring that local stakeholders possess the necessary competency to manage environmental initiatives independently. The training focused not only on technical knowledge of the recharge wells and conservation park but also on communication strategies to deliver conservation messages effectively.

B. Operational Simulations and Mentoring

To bridge the gap between theory and practice, operational simulations were conducted to test the "One Day Tour" flow. This method is supported by Mkono (2016), who emphasizes that "performative authenticity" in tourism—achieved through rigorous rehearsal and mentoring—ensures that operational standards meet international tourist expectations. Mentoring (pendampingan) acted as a continuous quality control mechanism, allowing for real-time adjustments to the service delivery model.

C. Measured Impact and Outcomes

The impact of these interventions was measured using a pre- and post-test competency framework. This quantitative assessment of human capital readiness is consistent with the Kirkpatrick Model of training evaluation, often cited in tourism management literature (e.g., Pollice, 2018). The results indicated a significant increase in the community's management capability, technical understanding of water conservation, and service hospitality standards, ensuring that the field laboratory is managed professionally and sustainably.

C.1. Impact on Disaster Response Empowerment

The training, simulation, and coaching on disaster response focused on building the community's capacity to manage risks such as landslides, earthquakes, and floods. Measurement of the impact of the activity was carried out by distributing questionnaires before and after the implementation of the activity through the following 12 statements:

1) I know the types of disasters that might occur in my area (S1)
2) I understand the evacuation steps during a disaster (S2)
3) I know who to contact when a disaster occurs (S3)
4) I can recognize the early signs of a disaster (S4)
5) I understand the importance of disaster simulations at school (S5)
6) I know how to provide first aid to disaster victims (S6)
7) I can remain calm and not panic during a disaster (S7)
8) I understand the importance of teamwork during a disaster (S8)
9) I know what emergency equipment to have at home (S9)
10) I am always prepared for potential disasters (S10)
11) I care about participating in disaster prevention efforts (S11)
12) I am ready to play an active role in preserving the environment around me (S12)

The comprehensive results of the empowerment level measurement are presented in **Tabel 1** and **Figure 4.**

Table 1
Pre-post-test for the impact on Disaster Response Empowerment

No. of statement	No. of respondent	Pre-test Strongly agree (%)	Agree (%)	Not agree (%)	Strongly not agree (%)	Post-test Strongly agree (%)	Agree (%)	Not agree (%)	Strongly not agree (%)
1	144	32.60	65.30	2.10	0.00	34.50	62.10	3.40	0.00
2	144	20.80	73.60	5.60	0.00	33.30	66.70	0.00	0.00
3	144	21.50	72.90	5.60	0.00	31.00	67.60	1.40	0.00
4	144	20.80	63.90	15.30	0.00	25.30	67.80	6.90	0.00
5	144	47.20	51.40	1.40	0.00	52.90	43.70	3.40	0.00
6	144	16.70	66.00	16.70	0.60	32.20	65.50	2.30	0.00
7	144	29.20	61.10	9.70	0.00	26.40	65.50	8.10	0.00
8	144	42.20	55,60	2.00	0.00	42.50	55.20	2.30	0.00
9	144	18.80	68.80	12.40	0.00	29.90	67.80	2.30	0.00
10	144	23.60	59.00	15.30	2.10	26.40	58.60	11.50	3.50
11	144	25.00	72.20	2.80	0.00	31.00	65.50	3.50	0.00
12	144	45.80	50.70	3.50	0.00	37.90	60.90	1.20	0.00
Total		344.40	760.50	92.40	2.70	403.30	746.90	46.30	3.50
Average		28.70	63.38	7.70	0.23	33.61	62.24	3.86	0.29
Empowerment (improvement)						4.91	1.13	3.84	0.07

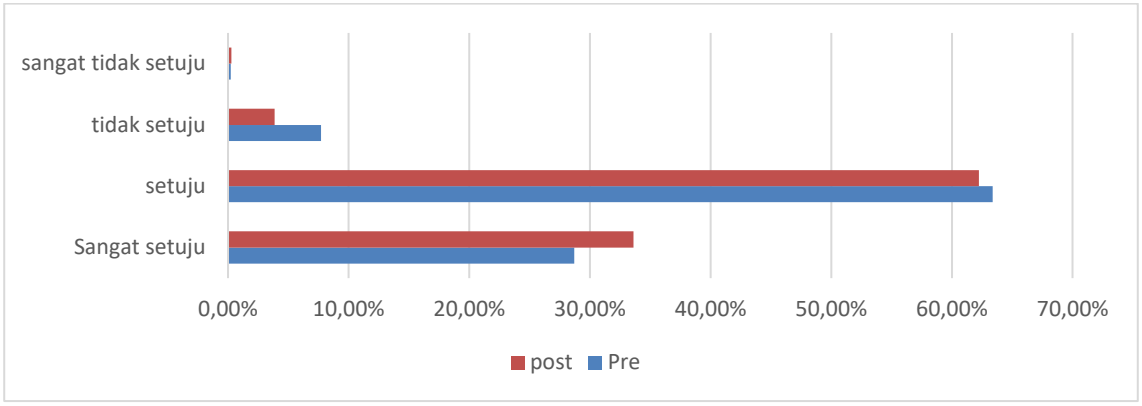

Figure 4. Level of Empowerment Improvement for Participants in Disaster Response Training, Simulation, and Mentoring

The analysis demonstrated a clear and significant increase in participant knowledge and understanding. This is evidenced by the substantial reduction in negative responses (disagree and strongly disagree) by 47.63%. This outcome reinforces the finding that structured community-based disaster risk reduction education is highly effective in enhancing local resilience (Najar et al., 2025). Furthermore, this activity successfully transformed knowledge into behavioural intentions, as demonstrated by 99% of participants reporting increased knowledge (Figure 4). Crucially, 83.90% of participants expressed their willingness and readiness to become Disaster Response Village Cadres (Figure 5). This high level of motivation for participation is a key indicator of successful community ownership, which is essential for maintaining the sustainability of rural tourism initiatives (Musavengane & Zhou, 2021).

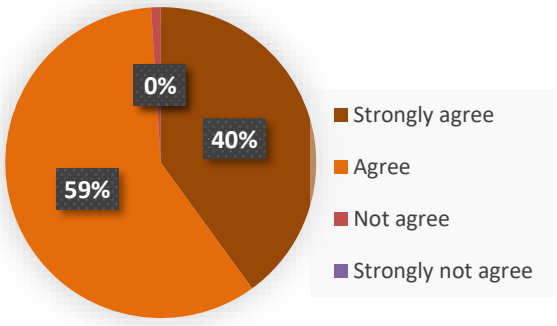

Figure 4. Improving the Understanding and Knowledge of Participants in Disaster Response Training, Simulations, and Mentoring

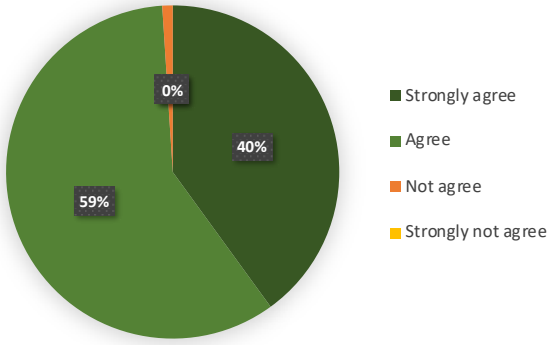

Figure 5. Increasing participants' willingness to become Disaster Response Village cadres

C.2. Impact on Ground Water Conservation and Agriculture Awareness

This segment measures the change in knowledge and competence of the 40 members of the Farmer Groups (*Poktani* Subak Yeh and Subak Abian) after receiving training and coaching on conservation/eco-friendly agriculture. Measurement of the impact of the activity was carried out by distributing questionnaires before and after the implementation of the activity through the following 7 statements:

1) I feel more aware of the importance of groundwater conservation
2) I plan to implement rainwater harvesting method at home
3) I will encourage neighbours or communities to do greening
4) I started sorting the trash at home regularly
5) I am ready to be an agent of change in environmental management
6) I feel more responsible for the preservation of groundwater resources
7) This training increased my desire to be involved in groundwater resource conservation activities

The comprehensive results of the empowerment level measurement are presented in Tabel 2 and Figure 6 and Figure 7.

The results show a profound and highly successful increase in the competence of the farmer groups. The percentage of participants categorized as ' Know' the subject matter surged from 22.14% in the pre-test to 75.00% in the post-test, an impressive increase of 238.75%. More importantly, the 'Don't know' category was successfully eliminated, dropping from 29.29% to 0%. These very positive results support the finding that focused conservation and agricultural extension and training programs have proven highly effective in increasing knowledge and encouraging the adoption of sustainable agricultural systems and practices at the farmer level (Apriyanto et al, 2025).

Table 2
Pre-post-test for the impact on Conservation and Agriculture

No. of Statement	No. of (respondent)	Pre-test			Post-test	
		Know (respondent)	Know little (respondent)	Don't know (respondent)	Know (respondent)	Know little (respondent)
1	40	10	20	10	32	8
2	40	14	16	10	32	8
3	40	8	26	6	34	6
4	40	10	20	10	32	8
5	40	6	18	16	28	12
6	40	4	10	26	24	16
7	40	10	26	4	28	12
Total		62	136	82	210	70
Average		8,86	19,43	11,71	30,00	10,00
Improvement		22,14%	48,57%	29,29%	75,00%	25,00%

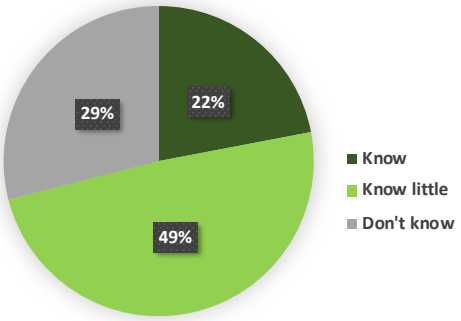

Figure 6. Score of partners' knowledge and competency levels in conservation and agriculture before training

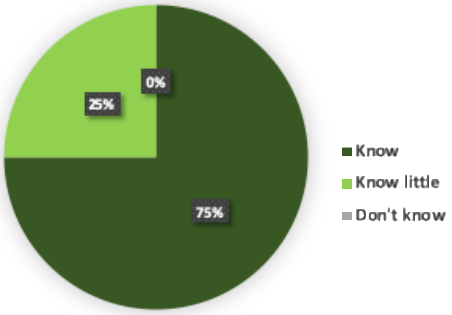

Figure 7. Score of partners' knowledge and competency levels in conservation and agriculture after training

C.3. Impact on Behaviour and Environment Awareness of Waste Management Training and Simulation
Improving community behaviour and awareness of environmental conservation to prevent natural disasters was carried out through training, simulations, and mentoring on waste management which apply 3 R system (Reduce, Reuse, and Recycling). The activity was attended by 21 community members, including farmers, tourism awareness groups, women's groups (PKK), and the general public.

The success or positive impact of the training was measured by distributing a questionnaire consisting of 10 statements, 5 statements as the parameters of the behaviour and awareness and the other 5 statements for the competency in using the garbage shredder. The statements was as follows.

1) I know what is meant by 3R waste management system and its function
2) I can differentiate between organic and inorganic waste
3) I understand the importance of shredding organic waste before composting
4) I know the benefits of organic waste processing for the environment
5) I am interested in using a shredder in waste management in my environment
6) I know how to turn on the organic waste shredder machine
7) I know how to fill the organic waste shredder
8) I know how to clean the organic waste shredder machine
9) I know how to maintain an organic waste shredder so that it lasts
10) I know about the safety procedures when using the organic waste shredder machine

The comprehensive results of the pre-post-test are presented in Tabel 3, Table 4, Figure 8.

Table 3
Pre-test Result for the Impact on Behaviour and Environment Awareness of Waste Management Training and Simulation

No. of Respondent	Statement 1 to 10 (Pre-test)									
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
1	5	5	5	5	5	5	5	5	5	5
2	5	5	4	5	5	5	5	4	4	4
3	5	5	5	5	5	5	5	5	5	5
4	4	4	4	4	4	4	4	4	4	4
5	4	4	4	4	4	4	4	4	4	4
6	4	4	4	4	4	4	4	4	4	4
7	4	4	4	4	4	4	4	4	4	4
8	4	4	4	4	4	4	4	4	4	4
9	5	4	4	4	4	5	5	5	5	5
10	5	4	4	4	3	4	3	3	3	3
11	5	5	5	5	5	2	2	2	2	2
12	5	5	5	5	5	1	1	1	1	1
13	5	5	5	5	5	3	3	3	3	3
14	5	5	5	4	4	5	3	3	3	3
15	5	5	4	5	4	5	3	4	4	3
16	5	5	4	5	4	5	3	4	4	3
17	5	5	5	5	5	4	4	4	4	4
18	5	4	4	5	4	4	4	4	4	4
19	5	5	5	5	5	4	4	4	4	4
20	5	4	5	5	5	4	3	3	3	3
21	4	5	4	5	4	3	3	3	3	3
Total/Statement	99.00	96.00	93.00	97.00	92.00	84.00	76.00	77.00	77.00	75.00

Average/statement	4.71	4.57	4.43	4.62	4.38	4.00	3.62	3.67	3.67	3.57
Total overall										41.24
Average overall										4.12
Total average for the machine (S6 to S10)										18.52
Average for the machine (S6 to S10)										3.70

Table 4
Post-test Result for the Impact on Behaviour and Environment Awareness of Waste Management Training and Simulation

No. of Respondent	Post-test									
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
1	5	5	5	5	5	3	4	2	3	5
2	5	5	5	5	3	3	4	3	3	5
3	5	5	5	5	4	4	4	3	4	5
4	5	5	5	5	5	3	4	3	3	5
5	5	4	5	5	4	5	4	5	5	5
6	5	4	5	5	4	5	5	4	5	5
7	5	4	5	4	5	5	5	4	5	5
8	5	4	5	4	5	4	5	5	4	5
9	5	4	5	5	4	5	5	5	5	4
10	5	5	5	5	5	5	5	5	5	5
11	5	5	5	5	5	5	5	5	5	5
12	5	5	4	5	5	5	5	4	4	5
13	4	4	4	4	4	4	5	4	4	4
14	5	5	5	5	5	5	5	5	5	5
15	5	4	5	5	4	5	4	5	5	4
16	4	4	5	4	4	4	4	5	4	4
17	4	4	5	4	4	4	4	5	4	4
18	5	4	4	5	4	3	4	3	3	3
19	5	5	3	3	3	3	3	3	3	3
20	5	4	4	4	3	4	3	3	3	3
21	5	5	5	5	5	5	5	5	5	5
	102	94	99	97	90	89	92	86	87	94
	4.86	4.48	4.71	4.62	4.29	4.24	4.38	4.10	4.14	4.48
Total overall										44.29
Average overall										4.43
Total average for the machine (S6 to S10)										21.33
Average for the machine (S6 to S10)										4.27

Table 5
Average overall (Pre-post-test)

	Average	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	overall Average
Pre-test	S1-S10	4.71	4.57	4.43	4.62	4.38	4.00	3.62	3.67	3.67	3.57	4.12
	S1-S5											4.54
	S6-S10											3.70
Post-test	S1-S10	4.86	4.48	4.71	4.62	4.29	4.24	4.38	4.10	4.14	4.48	4.43
	S1-S5											4.59
	S6-S10											4.27
Progress	S1-S10											7.39%
	S1-S5											1.05%
	S6-S10											15,17%

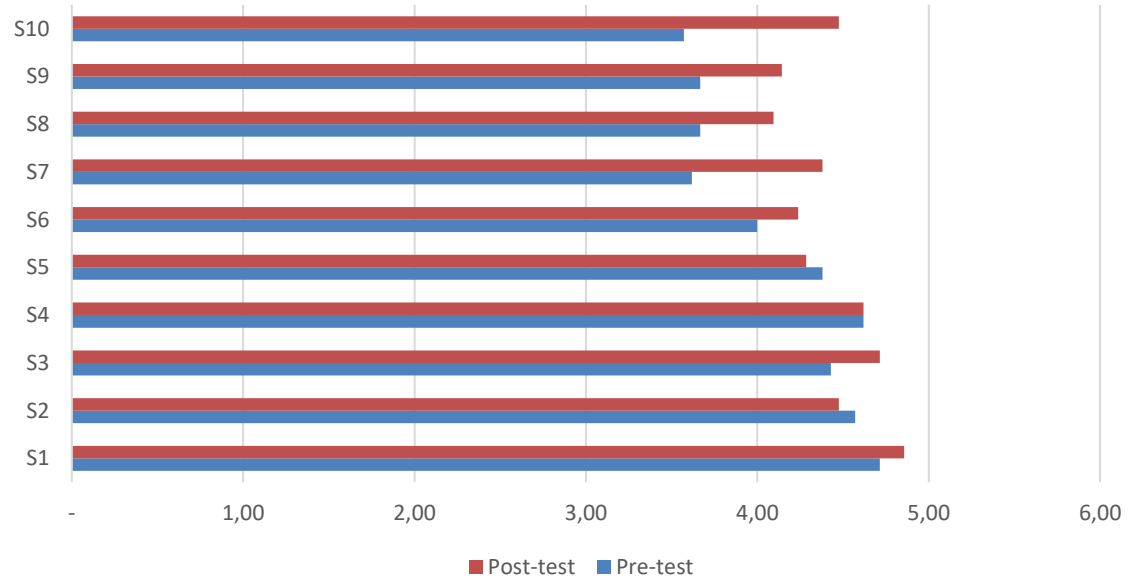

Figure 8. The Impact on Behaviour and Environment Awareness of Waste Management Training and Simulation (Average overall Pre-post-test)

The data presented in Table 3, Table 4, and Figure 8 reveal a critical insight into the dynamics of community engagement. While the marginal increase in general awareness and behaviour (1.05%) suggests a ceiling effect—indicating that pro-environmental attitudes were already established prior to the intervention—the substantial surge in technical skills (15.17%) highlights that the primary barrier to participation was structural capability rather than lack of concern. This finding aligns with the "Value-Action Gap" theory, which posits that high environmental awareness does not automatically translate into pro-environmental behaviour without specific enabling skills. Research specifically within the Indonesian context confirms that while communities often possess high concern for

environmental issues, this potential remains dormant due to a lack of practical knowledge [43]. Consequently, the significant improvement in technical competency observed in this study demonstrates the effectiveness of the "Action Competence" approach. By equipping the community with the necessary "how-to" knowledge (technical skills), the program successfully bridged the gap between passive concern and active contribution, transforming participants into qualified agents of waste management (Jensen & Schnack, 1997; Sunari & Nurhayati, 2023; Zuvianti & Outra, 2023).

Research Implications

The Integrated Conservation Edu-tourism Model offers significant contributions to both the scientific community and tourism practitioners. By bridging the gap between technical water conservation and experiential tourism, the study yields the following implications:

Academic Implications

From a theoretical and methodological standpoint, this research contributes to the academic literature by providing:

- **The Establishment of an Integrated Model**: This study offers a comprehensive conceptual framework for edu-tourism that synthesizes physical infrastructure with human capital development.
- **Operational Tools for Sustainable Tourism**: The research provides specific operational tools that can be used by scholars to study the management of conservation-based destinations.
- **Impact Measurement Instruments**: It introduces robust instruments for measuring the effectiveness of conservation interventions, ensuring that edu-tourism outcomes are quantifiable and scientifically valid.
- **Existing Potency Identification**: The study provides a methodological instrument to identify and evaluate the existing environmental and social potential of a site before developing edu-tourism initiatives.
- **Advancement in Water Security Discourse**: By integrating rainwater harvesting as a core tourism feature, this work supports the global academic call to use Rainwater Harvesting (RWH) as a primary tool to confront water scarcity.

Practical Implications

For practitioners, local governments, and community stakeholders, the practical applications of this model include:

- **Creating Management Awareness**: This model fosters a deeper awareness among tourism managers regarding the critical importance of conservation-based management in maintaining destination longevity.
- **Developing Operational Competencies**: Through the training and mentoring frameworks established in this study, practitioners gain the necessary competencies to run conservation tourism professionally and sustainably.
- **Fostering Community Resilience**: The emphasis on human capital readiness aligns with the principle that community-based education is essential for building long-term environmental resilience and independent management capabilities.

4 Conclusion

The development of the Integrated Conservation Edu-tourism (ICET) model in Sulangai Village demonstrates that the synergy between physical infrastructure and human capital is the cornerstone of sustainable destination management. This study concludes that:

1) Infrastructure as a Pedagogical Tool: The implementation of four units of Rainwater Harvesting (RWH) recharge wells and a miniature conservation park successfully transformed passive utilities into active educational platforms. This allows visitors to witness the practical integration of engineering and biology in addressing water scarcity.
2) Effectiveness of Capacity Building: The transition from passive environmental concern to active contribution requires structured, competency-based training. The research observed a profound increase in local knowledge, with "know" categories surging by 238.75% in agricultural conservation.

3) Bridging the Value-Action Gap: By equipping the community with specific technical skills (e.g., waste management and disaster response), the program successfully overcame structural barriers to pro-environmental behaviour.
4) Strategic Positioning: Based on the IFAS and EFAS analysis, the ICET model is highly viable for aggressive expansion, leveraging strong external market trends for nature-based education and "Desa Wisata" programs.
5) In summary, the ICET model serves as a transformative platform that inherently adheres to the Tri Hita Karana philosophy, ensuring that tourism growth harmonizes environmental preservation with community empowerment and spiritual reflection

Conflict of interest statement
The authors declared that they have no competing interest.

Statement of authorship
The authors have a responsibility for the conception and design of the study. The authors have approved the final article.

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