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Behavioral Patterns of Local Communities in Responding to Climate Change Challenges in Tourism in Seribu Islands

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ABSTRACT: Global climate change significantly affects marine-based tourism that depends on coastal ecosystem stability. The Seribu Islands, as one of Indonesia's prime tourism destinations, face serious threats such as sea-level rise, coastal erosion, ecosystem degradation, and an increased frequency of tidal flooding, all of which have implications for both environmental and economic sustainability of local communities. This study provides a context-specific examination of how small island communities adapt to climate change challenges in the tourism sector, thereby addressing an empirical gap in current tourism and climate literature. A qualitative approach with a case study design was employed on four inhabited islands (Tidung, Pramuka, Pari, and Kelapa). Informants were selected through purposive sampling and included local stakeholders in tourism and community leadership. Data was collected through in-depth interviews, participatory observation, and document analysis, and subsequently analyzed using thematic analysis. The findings reveal that local communities apply adaptation strategies across three main dimensions: (1) economic, through business diversification, digital innovation, and the utilization of local resources; (2) environmental, through ecosystem conservation, participatory waste management, and the efficient use of energy and water; and (3) socio-institutional, through collective action, strengthening of social networks, and collaboration with government, and NGOs. These results underscore that successful adaptation is determined by the integration of economic, environmental, and social aspects, and is not uniform across the islands, with Pramuka Island demonstrating greater preparedness compared to the others.

Keywords: Climate Change, Tourism, Community Behavior, Adaptation Strategies, Seribu Islands.

INTRODUCTION

According to the Intergovernmental Panel on Climate Change (Calvin et al., 2023) , over the past decade, environmental issues such as global warming, climate change, greenhouse gas effects, and pollution have increased significantly. Human activities, including excessive energy and water consumption as well as the uncontrolled exploitation of natural resources, have been identified as the main drivers of these issues (Judijanto et al., 2023)

Tourism is among the most affected economic sectors by climate change, while at the same time serving as a significant contributor to greenhouse gas emissions (Salsabilla & Rochman, 2024). The development of the tourism industry has a dual impact. On the one hand, tourism operations require high levels of energy consumption and contribute to waste generation and carbon dioxide emissions. On the other hand, the sector also plays a crucial role in driving economic growth and promoting cultural preservation, which benefit local communities. Over time, awareness of sustainable tourism has grown considerably, given the sector's significant role in the economy. The relationship between climate change and tourism is both close and complex (Juliani et al., 2021).

The tourism sector is highly vulnerable to rapid and sudden climate change impacts such as flooding, sea-level rise, tidal waves, storms, and high waves. One of the most pressing consequences of climate change is sea-level rise (Azuga, 2021), which poses significant risks to the sustainability of marine tourism destinations and coastal communities. The Seribu Islands, located in Jakarta Bay in the northern part of the Special Capital Region of Jakarta, represent one of Indonesia's ten national priority tourism destinations, as stated by the Ministry of Tourism and Creative Economy. As a designated national priority destination, the Seribu Islands face severe threats from the climate crisis. According to a report by WALHI (Indonesian Forum for the Environment) published in Tempo (2023), 23 islands along the Jakarta coastline are at risk of submergence due to sea-level rise, including several in the Seribu Islands, which are particularly vulnerable to climate-induced inundation (Ridwanuddin et al., 2022). These findings are consistent with the study by (Hidayah, 2022), which emphasizes that sea-level rise contributes to tidal flooding and the potential submergence of Jakarta's coastal areas. For instance, Tikus Island within the Pari cluster exemplifies the risk of submergence. Recent studies projecting sea-level rise in Jakarta for the period 2020–2040 indicate a significant upward trend. The figure below presents both the observed values (Real SLR Value) and the projected values (Predicted SLR Value) of sea-level rise in Jakarta(Rais et al., 2022) .

Gambar 3. Prediksi nilai kenaikan muka air laut Teluk Jakarta 2040

The data indicate that sea-level rise in Jakarta Bay shows a significant upward trend, particularly approaching the year 2040. This phenomenon directly affects the Seribu Islands as a marine tourism destination highly dependent on coastal environmental conditions. Rising sea levels may

result in coastal erosion, the submergence of small islands, and increased risks of abrasion and saltwater intrusion, all of which can damage coastal ecosystems and tourism infrastructure (Triana, 2020). The northern coast of Java is particularly vulnerable to flooding due to its relatively flat topography, allowing seawater to penetrate far inland (Egaputra et al., 2022).

To mitigate the negative environmental impacts, it is essential to promote education on the behavioral patterns of local communities in addressing climate change. Assessing and improving community behavior provides the foundation for implementing effective mitigation and adaptation strategies to address climate risks (Handayani et al., 2020). Mitigation aims to reduce the increase in atmospheric greenhouse gas concentrations by lowering emissions, while adaptation focuses on adjusting to the changes that have already occurred in order to minimize the adverse impacts of a changing climate. These two strategies are inseparable, as successful mitigation will ultimately reduce the need for adaptation (Rahmayanti et al., 2022) .

Understanding the behavioral patterns of local communities in responding to climate change challenges to tourism in the Seribu Islands is essential, as a significant portion of the population relies on tourism as their primary source of income whether through homestays, boat rentals, tour guiding services, seafood-based culinary businesses, or handicrafts. When climate change begins to disrupt tourist access, damage facilities, or reduce visitation, local communities are compelled to develop alternative strategies to sustain their livelihoods. Community awareness and active participation in environmental conservation play a crucial role in maintaining tourism attractiveness and ensuring local economic sustainability (Fauzan & Burhanuddin, 2023). Although numerous studies have examined the impacts of climate change on tourism, few have specifically explored behavioral adaptations within marine tourism, particularly in small island destinations such as the Seribu Islands, which remain underrepresented in existing literature. This study fills that gap by providing an in-depth exploration of how local communities interpret, respond to, and adapt to the climate change challenges they directly experience (Mira et al., 2019)

This study aims to explore the adaptive behavioral patterns adopted by local communities engaged in tourism-related economic activities in responding to climate change challenges in the Seribu Islands. The findings are expected to provide an empirical basis for formulating policies and strategies for sustainable tourism development grounded in local wisdom and the actual needs of the community. In this way, the socio-ecological resilience of the Seribu Islands can be strengthened, with the goal of designing adaptation interventions that are both contextual and participatory. Through this holistic approach, the Seribu Islands are expected to serve as a model for other tourism destinations in Indonesia facing similar challenges.

METHOD

This study applied a qualitative approach with a case study design. This design was chosen because it provides a comprehensive understanding of complex social phenomena, particularly how local communities adapt to climate change in the tourism sector. The case study approach enables holistic analysis of phenomena within real-life contexts by considering environmental, social, and economic factors (Creswell, 2013).

The researcher acted as the primary instrument responsible for planning, data collection, and analysis. Informants were selected purposively based on their involvement and experience in addressing climate change impacts on tourism. They included homestay owners, tour guides, tourism-related MSME actors, marine transport providers, community leaders, village officials in charge of tourism and environmental affairs, and local environmental activists. Between 15 and 20 informants were interviewed until data saturation was reached.

The study was conducted on four inhabited islands that serve as major tourism destinations in the Seribu Islands: Tidung, Pramuka, Pari, and Kelapa. These locations were selected purposively based on two criteria: (1) relatively large local populations and (2) significant intensity of tourism activities. The four islands represent diverse socio-economic and environmental conditions relevant to community adaptation (Setiawati et al., 2023).

The primary research instrument in this study was the researcher (human instrument), who played a central role in planning, collecting, analyzing, and interpreting the data. To support the data collection process, several tools were employed, including an in-depth interview guide, participatory observation sheets, audio recorders, cameras for visual documentation, and a checklist of documents to be reviewed.

Three techniques were employed. First, participatory observation was used to document economic practices, adaptive behaviors, and social interactions related to climate change. Second, in-depth interviews were conducted to capture community perspectives, experiences, and adaptation strategies. Third, document analysis involved reviewing village records, weather reports, environmental data, and relevant publications to strengthen and verify field data.

Data analysis involved transcription, coding, and thematic identification. Key themes included adaptation strategies, livelihood changes, and perceptions of climate change risks. A thematic analysis was then applied to explore relationships among these themes.

Data validity was ensured through triangulation: (1) source triangulation by comparing information from different informants, (2) methodological triangulation by combining observation, interviews, and documents, and (3) temporal triangulation by collecting data at different times. Member checking was also conducted by sharing the researcher's interpretations with informants to confirm accuracy and contextual relevance.

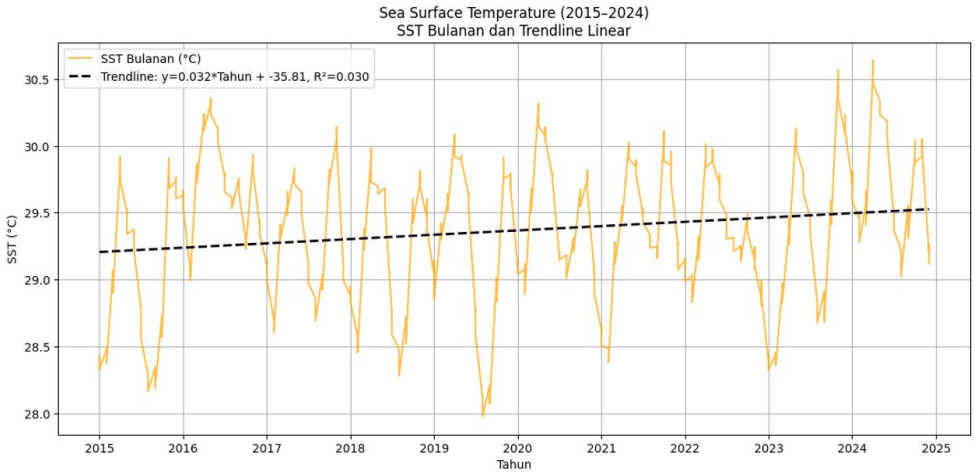
This study was conducted in accordance with the principles of qualitative research ethics. All informants were provided with a clear explanation of the study's objectives, benefits, and procedures, and their voluntary participation was secured through informed consent. The confidentiality of participants' identities was carefully maintained, and they retained the right to withdraw from the study at any stage without any consequences. The collected data were used solely for academic purposes, and the findings are presented anonymously to ensure the protection of participants' privacy.

RESULT AND DISCUSSION

General Description of the Research Site

This study was conducted in the Seribu Islands, DKI Jakarta, focusing on four inhabited islands that serve as popular tourist destinations: Tidung Island, Pari Island, Kelapa Island, and Pramuka Island. The sites were purposively selected based on two main considerations: the active involvement of local communities in the tourism sector and the vulnerability of these areas to the impacts of climate change. Although each island possesses distinct geographical characteristics, all of them are directly exposed to risks such as sea-level rise, coastal abrasion, and the increasing frequency of tidal flooding (Setiawati et al., 2023).

Recent climate analysis using ERA5 Sea Surface Temperature (SST) reanalysis data for the period 2015–2024 indicates that the waters surrounding the Seribu Islands have experienced a warming trend of approximately 0.032 °C per year, or 0.32 °C per decade. The average sea surface temperature ranges between 28–30.5 °C, displaying a distinct seasonal pattern, with peak temperatures typically occurring in April-May and November-December. This warming trend is particularly noteworthy, as elevated sea temperatures heighten the risk of coral bleaching, disrupt the reproductive cycles of marine species, and threaten the structural stability of coastal ecosystems, which underpin both tourism and fisheries in the Seribu Islands. Furthermore, such thermal stress can reduce biodiversity, alter species composition, and compromise the resilience of ecosystem services that local communities rely upon. Collectively, these findings highlight that the medium-term trend of ocean warming is not only an environmental concern but also poses socio-economic challenges, emphasizing the need for adaptive management strategies to safeguard the ecological and livelihood systems of the region (ERA5 Data, 2015–2024).



(ERA5 Data, 2015–2024; processed with Python, 2025).

In this context, the active involvement of local communities in the Seribu Islands is essential for fostering adaptive behaviors in response to the impacts of climate change. Community participation may take the form of ecosystem-based resource management practices, livelihood diversification, and engagement in environmental initiatives such as mangrove conservation, waste management, and climate education. Such adaptive behaviors not only strengthen ecological resilience but also enhance the socio-economic resilience of coastal communities. Accordingly, the

success of adaptation efforts in the Seribu Islands depends on the synergy between scientific strategies, government policies, and collective community awareness in safeguarding the sustainability of coastal areas.

Pramuka Island stands out as the most prominent location in terms of community readiness for climate change adaptation. Based on field observations and interviews with local residents, the island has developed a number of community-based initiatives, ranging from effective waste management and mangrove conservation to energy efficiency and environmental education. These efforts are aligned with the 2024 ProKlim (Climate Village Program) Award, granted to the administrative area of Pulau Panggang Village, which encompasses Pramuka Island. This recognition reflects a strong sense of collective awareness and institutional support for climate mitigation and adaptation at the local level. The findings further indicate that adaptation to climate change is not uniform across the Seribu Islands. Other islands, such as Pari, Kelapa, and Tidung, continue to face significant challenges in fostering community readiness and developing adequate infrastructure. Several residents reported experiencing tidal flooding more than three times within the last two months, yet no effective early warning mechanisms or evacuation systems have been established.

This underscores the long-term ecological vulnerability of the Seribu Islands. As recorded in Farhan's (2012) study, four islands in the archipelago Ubi Besar, Ubi Kecil, Ayer Kecil, and Nyamuk Besar disappeared between 1913 and 1999, primarily due to destructive practices such as coral mining and fish bombing. Although the drivers differ from the present-day climate-related phenomena, the disappearance of these islands demonstrates a long-term vulnerability that requires systemic intervention. Accordingly, current community adaptation efforts, such as those observed on Pramuka Island, can be understood as a collective response to multilayered crises ecological, social, and economic. Local knowledge and past experiences thus serve as critical assets in shaping resilient and context-specific adaptive behaviors.

Patterns of Local Community Adaptive Behavior

Thematic analysis of field data revealed that local community adaptive behaviors toward climate change in the coastal areas of the Seribu Islands can be categorized into three main dimensions: adaptation in tourism-related economic activities, environmental management, and social–institutional interactions. These three dimensions are interrelated and collectively form adaptive strategies that sustain livelihoods while preserving environmental integrity. These findings are consistent with previous studies highlighting the importance of diversification and resilience within the tourism sector in addressing climate risks, the effectiveness of ecosystem-based approaches for coastal adaptation, and the critical role of local institutions and community engagement in community-based adaptation (Hsiao, 2022).

Community Behavior in Tourism-Related Economic Activities

Interviews with the majority of informants revealed that climate change has significantly affected the continuity of local economic activities, particularly among those whose livelihoods depend on the tourism sector. These impacts are experienced directly, as changes in environmental conditions influence the availability, quality, and consistency of tourism services.

One of the most frequently cited consequences is the increasing frequency and intensity of tidal flooding in coastal areas. This phenomenon has caused damage to various tourism-supporting facilities, particularly homestays, which serve as the primary accommodation for visitors. Beyond material losses due to repair and renovation costs, tidal flooding also reduces visitor comfort and diminishes the attractiveness of the destination.

Tourism entrepreneurs also reported a decline in tourist arrivals during the rainy season or periods of extreme weather. The increasingly unpredictable weather patterns often lead visitors to postpone or cancel their trips, resulting in decreased revenue. This condition further disrupts the organization of various marine tourism activities such as snorkelling, diving, and inter-island trips which are highly dependent on stable weather and sea conditions to ensure safety and comfort.

In addition, informants highlighted the rising costs of maintaining and repairing tourism infrastructure. More frequent coastal erosion and seawater inundation have forced business owners to carry out regular repairs, thereby increasing operational expenses. If these conditions persist, the profitability of tourism enterprises could decline, ultimately weakening the competitiveness of the destination.

Thus, the impacts of climate change not only cause temporary disruptions to tourism activities but also threaten the long-term economic sustainability of local communities whose livelihoods depend heavily on this sector. This condition underscores the importance of adaptation and mitigation strategies to minimize negative impacts while ensuring the continuity of the coastal tourism industry. As expressed by a homestay owner on Pari Island: *"*Rising sea levels often cause flooding in the courtyard of the homestay, reaching up to knee height. Such conditions create significant discomfort for visitors and frequently lead to booking cancellations." A similar situation is also experienced by communities on Tidung and Kelapa Islands, although most still respond passively by halting tourism activities whenever extreme conditions occur.

This condition has encouraged the emergence of adaptive behavioural patterns in the form of livelihood diversification, whereby local communities no longer rely solely on marine tourism activities but also begin to develop alternative ventures such as environmental education tourism, local culinary enterprises, and handicrafts. Such patterns reflect a growing collective awareness of the need to reduce economic vulnerability in the face of climate uncertainty (Suriansyah et al., 2021).

One form of adaptive behavior demonstrated by local communities in sustaining the tourism economy in the Seribu Islands is the diversification of non-marine businesses. Communities are no longer entirely dependent on marine-based activities such as snorkeling, diving, and island hopping, but have begun to develop alternative forms of tourism that are more resilient to extreme weather conditions. Environmental education tourism, for instance, including mangrove conservation, turtle breeding, and coral reef transplantation, has gained increasing popularity as it provides educational experiences while simultaneously supporting sustainability objectives. Such diversification allows tourism activities to continue even when weather conditions are unfavourable for marine-based tourism, while also broadening income sources for local communities.

The development of educational tourism in the Seribu Islands has also generated positive impacts on the management of community-based homestays. Beyond serving as accommodation facilities for visitors, homestays represent one of the primary sources of livelihood for local residents. The presence of tourists participating in programs such as mangrove conservation or turtle breeding, for instance, has increased occupancy rates, thereby enhancing household income (Pradhan, 2024).

Thus, homestays not only support tourism activities but also play a crucial role in driving the local economy. They make tangible contributions by creating employment opportunities, stimulating growth in culinary enterprises, and fostering the involvement of local micro, small, and medium-sized enterprises. This multifunctional role positions homestays as a central pillar in sustaining the community-based tourism economy.

Furthermore, a similar practice can be observed in the development of mangrove-based ecotourism and edu tourism in Wringinputih Village, Banyuwangi. This model has been proven to strengthen the economic and social impacts for coastal communities by integrating hands-on experiences into community-based tourism activities. The approach, which emphasizes local wisdom and active community participation in mangrove conservation, has positioned the area as an alternative destination that is both attractive and economically productive. This success has generated new employment opportunities and increased local community income (Purwowibowo et al., 2020).

Adaptive Community Behavior in Coastal Environmental Management

Environmental issues in marine tourism destinations often pose significant challenges to sustainability, including in the Seribu Islands. One of the primary concerns raised by local communities is the problem of waste, which originates not only from tourist activities but also from marine debris carried by ocean currents from Jakarta. This problem becomes particularly acute during holiday seasons, when the influx of visitors leads to an increased volume of waste.

Several residents of the Seribu Islands explained, "waste has become a serious issue on the islands, especially during holiday seasons and when ocean currents bring debris from Jakarta. Without proper management, it risks worsening marine pollution and reducing fish stocks." This statement reflects that waste has emerged as one of the most pressing environmental issues in the Seribu Islands. The accumulation of waste, particularly during peak tourist seasons and periods when ocean currents transport debris from Jakarta, has led to a decline in coastal environmental quality. Polluted waters not only disrupt ecosystem balance but also diminish the aesthetic appeal of tourism destinations.

In response, Pramuka Island has established the Rumah Hijau (Green House) as a facility for waste segregation and processing. The Rumah Literasi Hijau Foundation plays a central role in this initiative by developing conservation and environmental education programs, promoting climate change mitigation and adaptation, and managing waste through community empowerment models.

Figures 1 and 2. The Green House Foundation
Source: rumahliterasihijau.id

Local communities perceive solid waste management as a crucial adaptation strategy in responding to climate change. The establishment of Rumah Hijau is not merely regarded as a technical facility for sorting and processing waste, but also as a collective response to the increasing intensity of extreme weather events that often exacerbate the flow of waste into coastal areas. A similar initiative is also evident in Pramuka Island, Panggang Subdistrict, particularly in RW 04, which received top recognition in the national *Kampung Iklim* (ProKlim) program in 2022.

Figure 3: Certificate of the Best ProKlim Award 2022 in Pramuka Island

Source: kepulauanseribu.go.id

Figure 4: Climate Village (ProKlim) Seribu Islands

Source: Instagram kepulauan seribu

This program encourages residents to integrate climate change mitigation and adaptation actions into their daily lives, such as household-based waste management, environmental greening, and coastal ecosystem conservation efforts. The active participation of the community in RW 04 demonstrates a growing collective awareness of climate change impacts, while also illustrating how community-based environmental management can serve as a tangible strategy for enhancing the resilience of small islands to climate risks.

In the transportation sector, one local sea transport operator stated, "The operator has begun exploring strategies to enhance the fuel efficiency of their vessels. Escalating diesel prices and increasingly unpredictable weather conditions necessitate more efficient operational practices. Certain vessels are already subject to regular maintenance to mitigate excessive exhaust emissions. Ideally, the operator aims to transition towards more environmentally sustainable vessels; however, financial support remains a critical requirement." This account illustrates that adaptation in the transportation sector is not solely driven by cost-efficiency concerns but also reflects a growing awareness of the sector's contribution to greenhouse gas emissions and, consequently, to climate change. Routine engine maintenance represents a form of basic technical adaptation, although limited financial capital remains a major constraint to achieving a full transition toward environmentally friendly maritime transportation.

A similar adaptive practice is also evident in land-based mobility. Several residents explained that most of the community has begun to shift toward using electric bicycles as the primary mode of transportation on the islands. As one resident remarked: "In contemporary society, the use of electric bicycles has become increasingly prevalent. These vehicles offer several advantages, including lower costs, zero emissions, environmental sustainability, and enhanced comfort for daily commuting." This transition reflects the community's collective awareness of the need to reduce dependence on fossil fuels while simultaneously lowering carbon emissions. The adoption of electric bicycles not only supports low-carbon mobility but also represents an adaptive strategy to address climate change challenges, particularly in meeting the growing demand for sustainable transportation in small island settings.

In relation to energy, one respondent explained: "Electricity supply on the island is often unreliable, particularly during adverse weather conditions. Recently, some households and homestays have begun adopting solar panels. Although not yet widespread, these systems provide a valuable alternative during power outages or when fuel for generators is scarce." This statement illustrates that the use of solar energy is regarded as an important adaptive strategy to reduce dependence on fossil fuels while addressing the risks of unstable electricity supply caused by extreme climate conditions. Moreover, the adoption of renewable energy contributes to reducing carbon emissions, thereby supporting broader climate change mitigation efforts.

Meanwhile, in terms of ecosystem protection, a local community leader remarked: "Here we have turtle breeding sites and mangrove areas; if they are not protected, they could disappear. With rising sea levels, many coastal areas are already inundated. Therefore, together with community groups, we participate in conservation programs, such as planting mangroves and protecting turtles. This is crucial to ensure that ecosystems remain viable and continue to safeguard us from the impacts of climate change." Beyond turtle and mangrove conservation, local residents also

engage in a range of environmental initiatives, including coral reef transplantation to maintain marine biodiversity and regular beach clean-ups. These activities are not only aimed at preserving the aesthetic value of tourist destinations but also at strengthening the ecological resilience of coastal ecosystems in the face of climate change pressures.

The interpretation of the findings indicates that local communities possess a solid understanding of the interlinkages between climate change and ecosystem sustainability. Their adaptive strategies encompass waste management, pollution control, transportation efficiency, the utilization of solar energy, and ecosystem conservation through participatory approaches. The presence of initiatives such as the ProKlim program in RW 04 of Pulau Panggang further underscores that community-based adaptation (CBA) and ecosystem-based adaptation (EbA) complement one another in addressing climate change challenges in the Seribu Islands (Qomariah et al., 2021).

The community implements an EbA approach through mangrove conservation, coral reef transplantation, turtle breeding programs, and regular beach clean-ups. These efforts not only safeguard ecosystem sustainability but also provide natural protection against coastal erosion and tidal flooding. This finding is consistent with the IPCC (2023) report and reinforced by (Wen et al., 2025), who highlight the effectiveness of EbA strategies in coastal regions of Indonesia.

In addition, participatory waste management through the "Rumah Hijau" initiative, along with the adoption of renewable energy sources such as solar panels and the use of electric bicycles, signifies a transition towards low-carbon tourism. This initiative aligns with the concept of climate-smart tourism as articulated by (Jatayu et al., 2024) and is further supported by (Salsabila & Yuli Puspitasari, 2023), who emphasize the importance of reducing the carbon footprint of tourism activities through clean energy innovation and sustainable mobility. These efforts not only contribute to carbon emission reduction but also foster greater awareness among tourists and local communities regarding low-emission lifestyles, while simultaneously creating new economic opportunities rooted in green energy and sustainable tourism.

Adaptive Behaviours in Social Interaction and Institutional Dimensions

In responding to environmental pressures caused by climate change, communities in the Seribu Islands recognize the importance of social solidarity as a form of social capital that enables them to collectively address risks. A tangible manifestation of this adaptation is the practice of "*gotong royong*" (mutual cooperation) to cope with tidal flooding, repair damaged public facilities, and engage in environmental conservation activities. These practices are not only physical in nature but also serve to build social networks that reinforce the community's capacity to withstand crises.

On Pramuka Island, social and institutional adaptation has been relatively effective. The island is supported by a strong *Pokdarwis* (tourism awareness group) and a highly cohesive community. Residents routinely organize Jumat Bersih (Clean Friday), a weekly collective activity aimed at maintaining environmental cleanliness. This initiative involves coastal waste collection, maintenance of public facilities, and the planting of erosion-control vegetation in flood-prone areas. As one resident explained, "We believe that the Clean Friday activity is important not only

to keep the island clean but also to strengthen the bond among residents. Everyone participates, from homestay owners to fishermen, which fosters a stronger sense of togetherness."

Such activities not only maintain environmental cleanliness and aesthetic appeal but also enhance the community's adaptive capacity to climate change. For instance, collective efforts to manage tidal flooding can reduce the risk of damage to homes and infrastructure, while community involvement in mangrove conservation and coastal vegetation planting helps prevent erosion and maintain the balance of local ecosystems.

In contrast, on other islands, such as Pari Island, the *Pokdarwis* (tourism awareness group) operates sub optimally. Many tourism operators are reluctant to participate due to conflicting interests and unclear roles. Consequently, communal activities and conservation efforts are infrequently carried out, and most environmental cleaning programs remain dependent on government intervention, particularly from the Department of Environment and Forestry. As one resident of Pari Island stated, "When it comes to communal cooperation, it rarely runs smoothly. Many tourism operators do not want to join because of internal issues, so we can only wait for the department's schedule. Sometimes it feels ineffective because community participation is low."

This situation demonstrates that the success of social and institutional adaptation is highly dependent on the strength of local social networks, solidarity, and collective community commitment. Pramuka Island illustrates that an organized community, supported by an active *Pokdarwis* and a regular schedule of communal activities, is capable of creating higher adaptive capacity in response to environmental risks. Conversely, Pari Island shows that weak internal coordination and low community participation can hinder the implementation of adaptation strategies, despite formal support from government institutions.

The socio-institutional dimension also proves to be crucial, as social solidarity, communal cooperation, and the presence of tourism awareness groups (*Pokdarwis*) enhance community adaptive capacity. This social capital aligns with perspective on the role of social networks, trust, and collective norms in strengthening community resilience. A study by (Handayani et al., 2020)along the Java coast further demonstrates that social cohesion can reduce vulnerability to flooding. Nonetheless, adaptation across islands is not uniform. Pramuka Island exhibits higher readiness compared to Pari or Tidung, which still face challenges such as weak internal coordination and limited community engagement. This variation indicates that the success of adaptation is strongly influenced by the strength of local institutions, as emphasized by (Rachmatsyah, 2023), who found that the effectiveness of sustainable tourism implementation in the Thousand Islands is highly dependent on the role of local institutions.

Overall, this experience underscores that adaptation to climate change requires not only technical interventions but also the strengthening of social and institutional dimensions. Social capital, manifested through solidarity, mutual trust, and coordination capacity, emerges as a decisive factor in the success of community-based adaptation. Strong local institutions, such as the *Pokdarwis* on Pramuka Island, enable communities to undertake collective actions consistently and sustainably, thereby minimizing the adverse impacts of climate change.

The findings of this study indicate that local communities in the Thousand Islands have developed a multidimensional adaptation framework to respond to the impacts of climate change on the tourism sector. These adaptive strategies are not limited to technical adjustments but encompass economic, environmental, and socio-institutional dimensions that are mutually reinforcing.

The interpretation of these findings highlights that the three dimensions economic, environmental, and socio-institutional are not isolated entities but are interconnected. Business diversification has emerged as a key adaptive strategy among communities in the Thousand Islands, where dependence on marine tourism activities such as snorkelling and diving is gradually being reduced through the development of educational tourism, local culinary enterprises, and handicrafts. This approach aligns with (Ellis, 2000) concept of livelihood diversification and the findings of (Siahaan & Saputra, 2023), which emphasize that diversification based on local potential can enhance both income and skills within coastal communities. Nevertheless, such economic diversification can only thrive if coastal ecosystems are well maintained, while the success of conservation programs depends heavily on social solidarity and the capacity of local institutions. Accordingly, the adaptive behaviors of communities in the Thousand Islands can be understood as a holistic, community-based strategy that integrates economic, ecological, and social dimensions within a unified resilience framework.

Furthermore, these findings hold global relevance, particularly for small island tourism destinations in Southeast Asia and the Pacific that face similar challenges due to sea-level rise and intensified coastal hazards. The community-based adaptation strategies demonstrated by the Thousand Islands' residents can serve as an international learning model, illustrating how local communities leverage traditional knowledge, social capital, and technological innovation to sustain tourism under climate change conditions.

This study also makes an academic contribution by highlighting that coastal community adaptation in the Thousand Islands is not uniform across islands, underscoring the importance of context-specific approaches. Moreover, the research demonstrates that local institutions, such as tourism awareness groups (*pokdarwis*), can act as key actors in ensuring successful adaptation (Jatayu et al., 2024); (Salsabilla & Rochman, 2024). This evidence enriches the literature on community-based adaptation by providing empirical insights into how institutional capacity, social capital, and economic diversification interact in response to climate change.

From a policy perspective, this study offers several actionable recommendations. First, the strengthening of local institutions should be pursued through capacity-building programs, management training, and improved access to financial resources, enabling community groups to manage adaptation measures more independently. Second, the transition to renewable energy must be accelerated by providing subsidies for solar panels, establishing charging infrastructure for electric bicycles, and deploying clean energy facilities in both tourism areas and local settlements in the Thousand Islands. Third, multi-stakeholder collaboration should be enhanced by engaging government agencies, academia, NGOs, and the private sector to facilitate optimal knowledge transfer, technological support, and funding (Ramdani & Resnawaty, 2022).

Overall, this discussion underscores that the adaptive behaviors of the Thousand Islands' communities are not merely reactive responses to climate change but also represent opportunities

to develop a community-based sustainable tourism model. By reinforcing synergies across economic, environmental, and socio-institutional dimensions, supported by adaptive and participatory policies, the Thousand Islands has the potential to serve as a model for climate adaptation in coastal tourism destinations in Indonesia and the broader regional context.

Interpretation of Key Findings

The findings of this study demonstrate that the adaptive behaviors of local communities in the Thousand Islands are multidimensional and context-specific, framed through economic, environmental, and socio-institutional dimensions. This framing provides a valuable theoretical contribution by enriching the Community-Based Adaptation (CBA) and Ecosystem-based Adaptation (EbA) frameworks. Tourism business diversification and the utilization of digital technologies reflect economic strategies that reduce dependence on marine-based tourism, which is highly vulnerable to extreme weather, while simultaneously expanding livelihood opportunities for local residents. From an environmental perspective, ecosystem conservation practices, waste management, and the adoption of renewable energy demonstrate that the community perceives climate change not merely as a threat but also as an opportunity to advance the transition toward low-carbon tourism. On the social dimension, community solidarity and the strengthening of local institutions function as social capital that enhances collective resilience against climate-related risks.

This interpretation underscores that climate adaptation in small island destinations is not merely a short-term technical response but a holistic, community-based strategy that integrates economic, ecological, and social dimensions within a unified resilience framework. The relative success of Pramuka Island compared to other islands highlights that adaptive capacity is strongly influenced by institutional readiness and social capital, emphasizing the need for policy approaches that are context-specific and locally grounded rather than uniform. Consequently, this study contributes to the sustainable tourism literature by demonstrating that the sustainability of coastal destinations is largely determined by the ability of local communities to integrate economic innovation, environmental conservation, and social solidarity into their everyday adaptive practices.

Comparison with Previous Studies

To contextualize these findings within previous research, this section compares the adaptive behaviors observed in the Kepulauan Seribu with existing literature on coastal community responses to climate change. Beyond aligning with prior studies that emphasize livelihood diversification as a key factor in strengthening economic resilience, the findings of this study also resonate with broader debates on sustainable tourism, coastal adaptation, and community resilience, thereby reinforcing its relevance to interdisciplinary environmental studies. The concept of livelihood diversification, initially introduced by (Ellis, 2000) and discussed in (Kassie et al., 2017), and further reinforced by (Jayaweera, 2010), posits that broadening income sources can protect communities from external shocks, including climate change impacts.

Coastal ecosystem-based adaptation (EbA) involves leveraging natural ecosystems to strengthen resilience against climate-related hazards and minimize coastal risks such as erosion, flooding, and storm surges. These ecosystems function as natural protective barriers, reducing the impact of storm surges, controlling shoreline erosion, and mitigating flooding, while simultaneously

supporting fisheries, maintaining water quality, and preserving biodiversity. For coastal communities, EbA contributes to resilience by integrating nature-based approaches with local livelihoods, governance mechanisms, and long-term climate adaptation planning, thereby generating both ecological and socio-economic benefits (Favero & Hinkel, 2024); (Jones et al., 2020)

On the socio-institutional dimension, the strengthening of social networks through cooperation and the presence of community-based tourism groups (pokdarwis) aligns with the findings of (Gisevius et al., 2024), which highlight the critical role of social capital in enabling climate adaptation in coastal communities. This study underscores the significance of social capital in enhancing the adaptive capacity of coastal communities in response to climate change.

However, the research also revealed that adaptation across islands in the Seribu Island is not uniform, with Pramuka Island demonstrating relatively higher readiness compared to Pari or Tidung Islands. This finding contributes to the literature by emphasizing that community adaptation is strongly influenced by the strength of local institutions and the capacity of social capital. In this context, the results complement the work of (Rachmatsyah, 2023), which underscores the importance of local institutions in implementing sustainable tourism policies, while simultaneously highlighting the need for context-specific approaches to adaptation.

Limitations and Cautions

This study has limitations due to its focus on only four inhabited islands in the Thousand Islands (Kepulauan Seribu), which restricts the generalizability of the findings to other coastal destinations in Indonesia. Additionally, the use of a qualitative case study approach allows for in-depth understanding but does not provide quantitative measures of community adaptation levels. Therefore, the findings should be interpreted with caution, particularly when considering policy applications beyond the study area.

Recommendations for Future Research

Future research is recommended to expand the scope of study to other islands within the Thousand Islands (Kepulauan Seribu) as well as coastal destinations across Indonesia facing similar challenges. Comparative studies across destinations could enrich the understanding of variations in community adaptation strategies. Furthermore, research employing quantitative or longitudinal approaches could help assess the long-term effectiveness of implemented adaptation strategies. The development of participatory research is also important to formulate policy interventions that are more practical and aligned with the needs of local communities.

CONCLUSION

This study contributes to the understanding of how local communities in the Thousand Islands (Kepulauan Seribu) adapt to climate change within a tourism context. Beyond documenting strategies such as business diversification, ecosystem conservation, participatory waste management, and social network strengthening, the study highlights the importance of community-driven adaptation as a foundation for sustainable tourism. The unique value of this

research lies in showing how locally grounded initiatives, when supported by policy and multi-stakeholder collaboration, can create resilient socio-ecological systems in small island settings.

The broader implication is that sustainable tourism in coastal and island regions requires not only environmental and economic strategies but also strong community institutions and participatory governance. Although limited by geographic scope and qualitative design, the study underscores the potential for locally adapted practices to inform national and regional policies. Future research using comparative and mixed-method approaches could further expand this knowledge and generate more actionable guidance for policymakers and practitioners in promoting climate-resilient tourism.

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