

# Harnessing Climate Literacy as a Stimulant for Economic Growth through Sustainable Conservation at Pelangi Beach

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## ABSTRACT

Climate literacy is a crucial strategy for addressing climate change and enhancing public awareness of environmental conservation. By gaining a deeper understanding of how ecosystems function and the ways in which humans interact with the environment, society can more actively engage in efforts to mitigate and adapt to climate change. Pelangi Beach located in Kretek, Bantul, Yogyakarta, is renowned as a turtle conservation site which presents opportunities and risks including climate change. However, there remains a significant gap between climate literacy and effective sea turtle conservation. Aims of this study is bridging the knowledge gap through targeted educational programs and workshops. Interviews and focus group discussions approach were employed to obtain a communal perspective in climate literacy. This analysis described the benefits of environmental conservation, highlights strategies for fostering climate literacy, and examines the positive impacts on local economies and community well-being. The turtle conservation site at Pelangi Beach can significantly boost the economic growth of local communities in ecotourism development, sustainable fishing practices, community engagement, education and awareness programs, grants and funding, cultural heritage, branding and marketing opportunities, partnerships with NGOs, research and education initiatives, development of eco-friendly products, infrastructure improvements, seasonal employment opportunities, community conservation programs, volunteer programs, and promoting local cuisine. Findings and approaches are relevant to Sustainable Development Goals 4, 8, 11, 13, 14, and 17. Harnessing climate literacy can create a holistic economic model that supports both environmental health and community prosperity, ensuring that local residents reap the benefits of protecting their natural heritage.

**Keywords:** Pelangi Beach, climate change, climate literacy, conservation, turtle

## INTRODUCTION

Climate change is one of the biggest challenges faced by global society today. Indonesia, as an archipelagic nation, has profound implications for its coastal areas, economy, culture, and biodiversity. Climate change has had real impacts on coastal areas, such as changes in rainfall, drought, and increasingly extreme temperatures (Burkett & Davidson, 2012). Coastal area like Pelangi Beach in Kretek, Bantul, Yogyakarta where the sea turtles are found and is acclaimed as a turtle conservation area also risk from rising sea levels and extreme weather events. This impact not only harms the agricultural and tourism sectors but also threatens the health and welfare of society as a whole. Therefore, climate literacy is crucial for increasing public awareness about the impacts of climate change and the adaptation strategies needed. Climate literacy can be an effective method for society to understand how ecosystems work and how humans interact with the environment (Azevedo & Marques, 2017). Climate literacy refers to the ability of individuals and communities to understand issues related to climate change, its impacts, and actions that can be taken for mitigation and adaptation (S Raj & S Amin, 2024; Azevedo & Marques, 2017).

The Pelangi Beach area, one of the beautiful and diverse coastal areas in the Yogyakarta region, was once a natural turtle breeding habitat. Sustainable conservation of the natural environment can help mitigate the impacts of climate change and ensure a safer future for the regeneration of living creatures including sea turtles (European Commission, 2009). The Pelangi Beach Turtle Conservation Group is a dedicated community project focused on protecting sea turtles and preventing their extinction. Once a thriving natural breeding habitat, the Pelangi Beach area has faced challenges since the neighboring Parangtritis and Depok Beaches became popular national tourist destinations. Turtles at Pelangi Beach are becoming less common these days, and their numbers are getting close to being extinct (Budiantoro et al., 2019). The beach is lies in Parangtritis Village, the hamlet of Grogol IX, Kapanewon Kretek, Bantul Regency, Yogyakarta (Figure 1). Community participation in reducing and avoiding disaster risks is important by increasing community awareness and capacity. Knowledge regarding physical and non-physical characteristics plays a role in determining risk elements and increasing community capacity, for example from an economic perspective. Village areas, functioning as production centers, have the potential to serve as key drivers of regional growth.

Utilization of natural resources requires wisdom and understanding of the characteristics of the environment. Quality of human resources who understand the characteristics of the surrounding environmental resources will determine the quality and sustainability of the natural resources utilized for their welfare (Goh et al., 2022). Communities that understand and recognize their environment, including potential natural hazards, can adapt their practices to harmoniously utilize resources in alignment with their surroundings (Jabbour et al., 2008). A community's resilience to its environment is put to the test when faced with unexpected events that exceed their daily experiences or mitigation efforts. The physical characteristics of a region significantly influence its economic development, presenting both opportunities and challenges. Coastal areas, for example, are susceptible to flooding and strong winds due to geomorphological and hydrometeorological factors. Community resilience in regional economics is shaped by the population's literacy and skills in understanding and adapting to their environment (Teräs, 2019).

In the context of sustainable development, especially related to environmental management, community resilience supported by local leaders will encourage a comprehensive understanding of the resources they have that can support regional resilience. Economic assessments for areas that have natural potential for development need to include the possibility of damage or loss due to natural events. It is very important to provide literacy regarding changes in weather factors, especially as a consideration for tourism management such as at Pelangi Beach. The aims of this community engagement project are:

1. To increase public knowledge regarding climate change, especially those that have the potential to have an impact on people's livelihoods (agriculture, tourism, etc).
2. To increase the capacity of human resources to support regional resilience, from an economic, ecological and social perspective.

## METHODS

The development of rural areas is a crucial component of successful progress in Indonesia. Along the way, various potentials and challenges may arise in village development. A qualitative study was employed to understand how a community or individuals perceive certain issues. The key community stakeholders including village government officials, farmer groups, tourism advocates, local economic developers, and other relevant parties were invited to participate in interviews and focus group discussions to address such issues. These discussions are essential for gaining a comprehensive understanding of the current challenges facing the community (Figures 2, 3, 4, and 5).

Twenty-five participants were involved in the FGD as well as in depth interview. The young generation groups, tourism activists, environmental observers, and regional economic actors in current conditions may not yet clearly see the connection, synergy, and direct influence of changes in climate factors on local economic activity to a wider regional scope. Some views (arguments) claimed that excessive exploitation for economic gain alone is the cause of environmental harm. Conversely, natural processes can also harm the environment

when their intensity or frequency increases, such as when a sudden hour of heavy rainfall surpasses the regional average. Environmental changes related to economics and natural factors need to be studied and reintroduced through education or training. Media can play a vital role in delivering environmentally friendly education by utilizing readily available materials from the surroundings. Below are examples of learning media that can be employed to help recognize environmental changes (see Figures 6, 7, 8, and 9).

The targets of this activity include:

1. Pelangi Beach Turtle Conservation Group
2. Prangtritis Subdistrict Government
3. Dusun Grogol IX Community

The analytical techniques employed in this study are as follows: (1) connecting, (2) separating, (3) contrasting, (4) quantifying, and (5) deleting. The technique of connecting involved establishing a rigorous and valid link between the statements made by the researcher and the actual data. Separating was defined by the need to distinguish between participants' categories (emic analysis), researchers' categories (etic analysis), and the perspectives of other authors. Contrasting was characterized by the recommendation to adopt a systematic approach for identifying recurring features or differences across settings. Quantifying involved guidance on counting or determining the extent of the data required to support the arguments. Finally, deleting was characterized by the advice to eliminate irrelevant material.

## FINDINGS AND DISCUSSION

### Findings

Coastal areas are at risk from rising sea levels and extreme weather events, which can threaten both the conservation efforts and local livelihoods. Significant tourism potential, including both mass and eco-tourism, exists in the Parangtritis subdistrict. An excellent illustration of this is Pelangi Beach, which the Grogol IX community voluntarily built as a tourist destination with educational value. Every turtle nesting season, visitors can see firsthand the egg collection and breeding process in the hatchery. Apart from that, there are educational programs that teach visitors about the importance of preserving turtles and their habitat. Pelangi Beach also offers a tranquil atmosphere and stunning sunset views, making it an ideal place to relax while supporting conservation efforts. With community awareness and participation, Pelangi Beach is committed to preserving turtle species and its coastal ecosystem. Understanding the importance of environmental conservation affected by climate change will also support economic strengthening.

Students, young people, and parents are invited to engage in a meaningful discussion about the knowledge they currently possess and the insights they have inherited from their predecessors, including family, peers, and the media. This conversation will explore the various adaptations to climate change that have been implemented in their communities, fostering a deeper understanding of both the challenges and solutions that exist. By sharing their experiences and perspectives, participants can contribute to a richer dialogue about environmental awareness and action. In groups with farmers, tourist activists, local government representatives, and other relevant stakeholders, the comparison of experiences across generations, media, and sectors was examined. The challenges we have faced and may continue to encounter, particularly in light of potential weather and climate changes, warrant collective discussion. It is crucial to recognize the changes that are occurring and their implications for our communities. By working together, we can identify and implement appropriate strategies tailored to our local conditions and characteristics, ensuring a proactive response to the evolving environmental landscape. All elements of society need to explore the interrelated factors of change, starting with disruption events from small to large scale that have an impact on household livelihoods and regional (hamlet/village) economies.

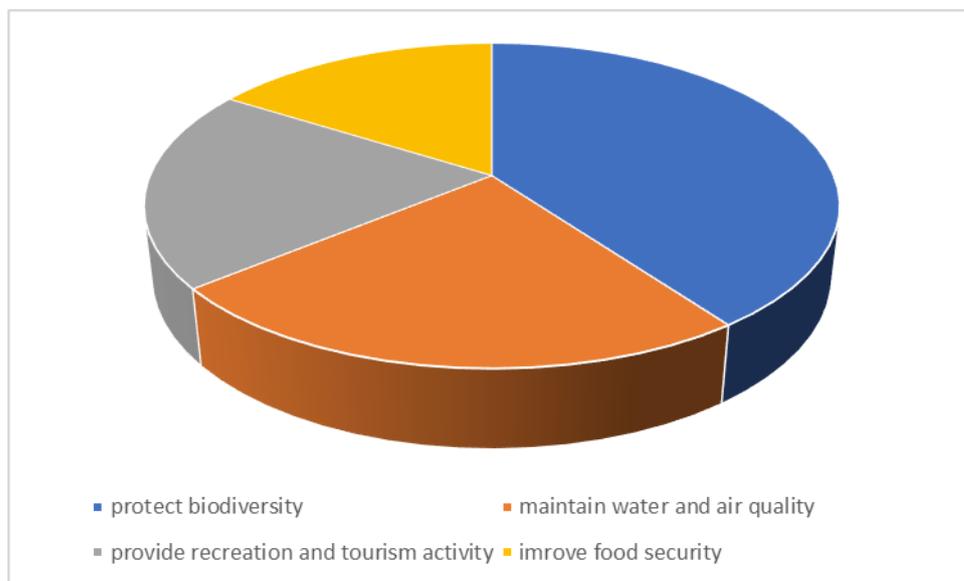
Focus group discussions were conducted to gather a comprehensive understanding of the community. Farmer groups, and local economic stakeholders were also invited to observe various monitoring equipment, including temperature recording devices, sunlight duration sensors, evaporation buckets, manual rain gauges, and Automatic Weather Stations. Comparisons of experiences across generations, media, and sectors were

discussed with groups of farmers, tourism advocates, local government officials, and other relevant members of society (Table 1).

Table 1. Comparison of experience in climate literacy between actors

Actors	Experience	Media	Sector
Young peoples	little experience	conversation between friends	Industry
Parents	lot of experience	word of mouth conversation	Agriculture
Formal Students	enough experience	books and social media	Service
Tourists	enough experience	Newspaper, social media	Mixed

The proportion of understanding regarding the benefits of sustainable natural environmental conservation among the various actors is depicted in the pie chart.



Based on the results of focused discussions among several community groups, an understanding was gained that sustainable natural environmental conservation has broad benefits, including:

1. **Ecotourism Development:** Turtle conservation can attract tourists interested in wildlife and nature. Guided tours, educational programs, and turtle-watching events can generate income for local businesses, including hotels, restaurants, and shops.
2. **Job Creation:** Conservation efforts require staff for monitoring, education, and management. This can create job opportunities for local residents, including roles in tour guiding, hospitality, and conservation management.
3. **Sustainable Fishing Practices:** By promoting a healthy marine ecosystem, turtle conservation can enhance fish populations. This benefits local fishermen by providing better catches, which can improve their livelihoods.
4. **Community Engagement:** Involving local communities in conservation efforts fosters a sense of ownership and responsibility, which can lead to sustainable practices that benefit both the environment and the economy.
5. **Education and Awareness Programs:** Workshops and training on sustainable practices can equip locals with skills and knowledge that may lead to new business ventures, such as artisanal crafts or sustainable agriculture.

6. **Grants and Funding:** Successful conservation initiatives often attract grants and funding from governmental and non-governmental organizations, which can be invested back into the community for infrastructure and development projects.
7. **Cultural Heritage:** Highlighting the importance of sea turtles can help preserve local culture and traditions, potentially creating unique cultural experiences for visitors and enhancing the region's attractiveness as a tourist destination.
8. **Branding and Marketing Opportunities:** The conservation site can help establish Pelangi Beach as a brand associated with environmental sustainability. This can attract eco-conscious tourists and businesses, leading to increased marketing opportunities for local products and services.
9. **Partnerships with NGOs:** Collaboration with non-governmental organizations can bring in resources, expertise, and funding for both conservation efforts and community development projects, creating further economic opportunities.
10. **Research and Education Initiatives:** The presence of a conservation site can attract researchers and students interested in marine biology and conservation. This can lead to educational programs that benefit local schools and create opportunities for locals to work as research assistants or educators.
11. **Development of Eco-Friendly Products:** Local artisans and entrepreneurs can develop and sell eco-friendly products, such as reusable bags or turtle-themed crafts, tapping into the growing market for sustainable goods.
12. **Infrastructure Improvements:** Increased tourism can lead to better infrastructure, such as roads, transportation, and sanitation facilities. These improvements not only benefit visitors but also enhance the quality of life for local residents.
13. **Seasonal Employment Opportunities:** During peak tourist seasons, conservation sites can create temporary job opportunities in hospitality and tourism, providing income for locals during times when other employment might be scarce.
14. **Community Conservation Programs:** Local residents can be incentivized to participate in conservation efforts through financial compensation for their work, such as monitoring nesting sites, which directly supports their livelihoods.
15. **Promoting Local Cuisine:** As tourism increases, there can be a rising interest in local cuisine. Restaurants that emphasize local ingredients and traditional dishes can thrive, supporting local farmers and fishermen.
16. **Volunteer Programs:** Creating volunteer opportunities for tourists can also generate income for local services, such as accommodation and food, while fostering a sense of community and shared purpose among visitors and residents.

Findings and approaches are relevant to Sustainable Development Goals (SDGs) numbers:

**SDG 4: Quality Education** - Emphasized through the focus on climate literacy, educational programs, and community engagement in understanding ecosystems.

**SDG 13: Climate Action** - Addressed by the emphasis on mitigating and adapting to climate change, as well as the importance of understanding human interactions with the environment.

**SDG 14: Life Below Water** - Relevant due to the focus on turtle conservation and protecting marine ecosystems.

**SDG 8: Decent Work and Economic Growth** - Highlighted through the discussion of ecotourism development, job creation, and economic benefits for local communities.

SDG 11: Sustainable Cities and Communities - Implicit in the mention of infrastructure improvements and community services that enhance local welfare and sustainability.

SDG 17: Partnerships for the Goals - Reflected in the collaboration with NGOs and the promotion of community engagement for better outcomes.

By integrating these strategies, turtle conservation can create a sustainable economic model that supports both environmental health and community prosperity, ensuring that local residents reap the benefits of protecting their natural heritage.

## Discussion

Opportunities and risks are crucial for the sustainable development of turtle conservation efforts at Pelangi Beach, ensuring that the community can thrive while protecting their natural heritage. Conservation of turtles and their habitats can protect biodiversity which is very important for the welfare of society. Biodiversity can make the environment resilient, and environmental resilience will ensure the stability of people's lives and livelihoods, both those who work by directly extracting natural resources, and in the commercial and service sectors (Patrício et al., 2021). Sand dune and coastal forest ecosystems function as carbon sinks of water and air pollution. Conserving sand dunes and coastal forests, apart from ensuring the preservation of habitat for turtles, will also have a positive impact on the quality of water and air in the area. There are direct and indirect benefits felt by local people and tourists (Araya-López et al., 2024).

Community food security can be improved by protecting turtles and sand dunes. Food security is not solely about the production of rice and other food crops, but also about environmental resilience to support people's lives and livelihoods. Without the support of natural conditions in accordance with their natural properties, the sustainability of food crop production and productivity will also be disrupted (Constas, 2023).

To increase climate literacy in the Pelangi Beach area, several implementation strategies can be implemented, including:

1. Education and Training: Participate in education or training programs regarding climate literacy to deepen community knowledge.
2. Participation in Conservation Projects: Get involved in environmental conservation projects such as tree planting, waste management, and ecosystem monitoring.
3. Implementation of Environmentally Friendly Principles: Applying environmentally friendly principles in daily activities, such as reducing the use of fossil fuels and using renewable energy.
4. Collaboration with NGOs and Communities: Using synergies with NGOs or communities to create environmentally oriented innovations.

These illustrates a comprehensive approach to sustainable development through education, environmental conservation, and economic growth. The existence of the Pelangi Beach Turtle Conservation Group is also a medium for improving the quality of human resources who are wise in managing the natural resources available in their environment.

## CONCLUSION

Climate literacy is an important strategy in dealing with climate change and increasing public awareness about the importance of sustainable natural environmental conservation. Sustainable conservation is not merely an environmental issue; it is integral to combating climate change and ensuring a viable future for all species, including vulnerable ones like sea turtles. This holistic approach underscores the interconnectedness of environmental health, biodiversity conservation, and climate stability. By understanding this, people in the

Pelangi Beach area can actively participate in the implementation strategy which have a significant positive impact on the local economy and community welfare.

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## CONFLICT OF INTEREST

The authors declare there are no conflicts of interest.

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**Figure 1.** Situation Map of Pelangi Beach



**Figure 2.** FGD with Community Members



**Figure 3.** In-class Climate Literacy to Community Members



Figure 4. Consultation about Turtle Health Care



Figure 5. Out-doors Climate Literacy to Community Members



Figure 6. Release of sea turtle hatchlings (tukik) by visitors



Figure 7. Participatory Information Boards as a Communication Medium

NO	WAKTU DITEMUKAN	JUMLAH TELUR	TANGGAL MENETAS	PERKEMBANGAN TELUR				PERKEMBANGAN TUKIK TGL DAN JUMLAH RILIS, TGL DAN JUMLAH MATI, DLL	KET
				JUMLAH MENETAS	GAGAL	MATI SAAT BARU MENETAS	MATI DALAM PERAWATAN		
1	21 Februari 2024	83 T=5	9 APRIL & 19 APRIL	49	75	34	22	Tahun 2022	@=sarang toples
2	16 APRIL 2024	81						Menetas: 70.7%	*1=18.00-22.00
3	17 APRIL 2024	103						Gagal: 29.3%	*2=23.00-03.00
4	3 MEI 2024	105						Tahun 2023	*3=04.00-08.00
5	3 MEI 2024	125						Menetas: 58.9%	→:Barat
6	4 MEI 2024	114						Gagal: 41.1%	←:Timur
7	10 MEI 2024	90							#: telur pecah
8	10 MEI 2024	DICARI orang							E=ekor
9	13 MEI 2024	75							T=kepala
10	15 MEI 2024	123							SA=Semai Alam
11	15 MEI 2024	36	T=60						Pe=pelemb
12	16 MEI 2024	10							Am=Amunisi
13	19 MEI 2024	88							D=Dan orang
14	19 MEI 2024	93							
15	21 MEI 2024	103							
16	23 MEI 2024	96							
17	25 MEI 2024	51							
18	26 MEI 2024	117	S.M=5, S.M=5						
19	27 MEI 2024	109	S.M=5, S.M=5						

Figure 8. Recording Board to Monitor the Progress of the Turtles



Figure 9. House Wall as a medium for Kid's Arts Creativity





Figure 12. Health Care for disabled adult sea turtle