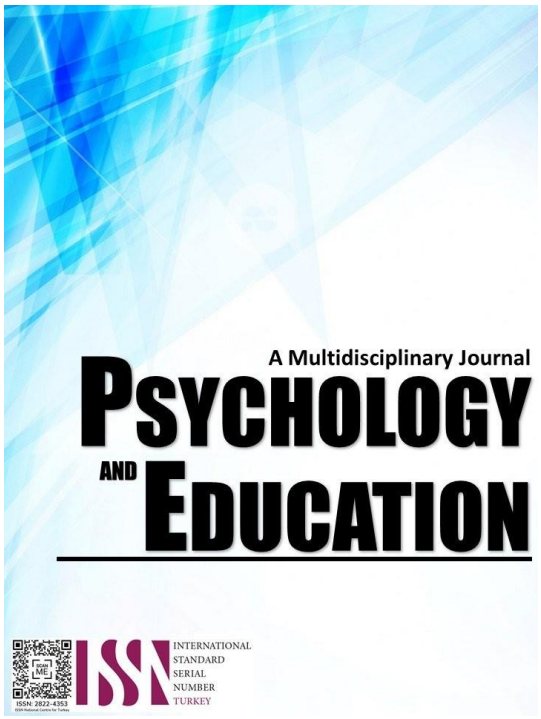
UNCOVERING THE ROOT CAUSES AND FAR- REACHING IMPACTS OF FLOODS AND LANDSLIDES IN BROOKE'S POINT, PALAWAN



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Research Article

Uncovering the Root Causes and Far-Reaching Impacts of Floods and Landslides in Brooke's Point, Palawan

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Abstract

The purpose of this research was to look at the core causes of recurring floods and landslides in Brooke's Point, Palawan, and to make suggestions to solve these concerns. Understanding local perspectives of the causes of floods and landslides, analyzing the impact of these catastrophes on the community, and suggesting potential strategies to lessen their consequences were among the research aims. A mixed-methods approach was utilized to collect data from affected individuals and stakeholders, including household surveys, key informant interviews, and field observations. Residents blamed the frequent floods and landslides on a combination of natural and manmade reasons, including climate change, poor land use practices, illegal logging, and mining operations, according to the results. The catastrophes had substantial social, economic, and environmental consequences for the community, including deaths, property destruction, and interruptions to livelihoods. Based on these findings, the study suggests that comprehensive flood and landslide risk management measures be implemented, community awareness and preparedness be increased, early warning systems and communication networks be strengthened, and environmental conservation and sustainable development be promoted. The suggested recommendations are projected to contribute to a more resilient and sustainable Brooke's Point community, capable of coping with and adapting to the increased dangers posed by floods and landslides as climate change and other environmental issues become more prevalent.

Keywords: *causes, environmental issues, impacts, floods, landslides*

Introduction

Hazards like floods and landslides result from an environmental change collectively called natural disasters (Sholihah et al., 2020). In the same way, natural disasters are part of the human environment (Moradi et al., 2019). Hence, calamities are never-ending, unavoidable, and inescapable. The natural disaster started long before contemporary people arrived on Earth and is probably here to stay for the foreseeable future (Lee, 2018). Natural disasters have created hazards to and difficulties for humankind's existence and well-being over time. (Guo, 2021). Environmental changes affect the environment and other environmental components (e.g., living and non-living). Although people cannot prevent natural disasters from occurring, they can mitigate their effects. To date, humans continue looking for solutions to limit the risk and danger that disasters could bring.

Every year, documents and reports show that floods and landslides have caused deaths, injuries, homelessness, damaged or destroyed buildings, roads, and other infrastructure (Department of Natural Resources, 2022), and economic losses (Onyango & Uwase, 2017). Over the past several decades, there has been an increase in the number of natural disasters worldwide, particularly storms and floods. (Asian Development Bank, 2013).

Flooding also has both positive and negative effects on the ecosystem. Talbot et al. (2018) found that severe flooding caused losses in the majority of ecosystem services (supporting services, regulating services, provisioning services, and cultural services), while a half of the ecosystem functions were neutrally or favorably impacted by small floods.

Weiskopf et al. (2020) explained the four (4) ecosystem services and their role in maintaining life. Provisioning services pertain to the basic needs of life to propagate, including water, food, and air. Regulating services refers to the ability of the ecosystem to maintain, retain, and moderate provisions that organisms need. Supporting ecosystem services helps fundamental ecosystem processes like primary production, nutrient cycling, and genetic diversity maintenance. Cultural services include things like identity in culture, recreation, and physical and mental wellness, which are non-material advantages humans get from biodiversity and ecosystems.

Floods and landslides are among the widespread reasons for destroying human lives, properties, and the environment (Glago, 2021). For over 30 years have passed, global flood disaster in 2021 was recorded as the most frequent, causing high death and economic losses (2021 Global Natural Disaster Assessment Report - OCHA, 2021). Just recently, in December 2022 alone, members of the Association of Southeast

Asian Nations (ASEAN) experienced 33 disasters, 22floods, and five (5) landslides (Janottama, 2022). Meanwhile, the Philippines experiences 20 typhoons annually on average, which increases the risk of tsunamis, drought, rising sea levels, storm surges, landslides, floods, flash floods, and flooding (Asian Disaster Reduction Center, 2019). 18 tropical cyclones entered the Philippine Area of Responsibility, or PAR, in 2022, resulting in flooding in Mindanao and landslides in Leyte (OCHA, 2023).

In the Philippines, landslides and flooding are two of the most frequent natural disasters. These take place because the nation is most susceptible to typhoons, tropical cyclones, and climate change. Reuter (2022) reports that in the Philippines, floods and landslides have resulted in several casualties, lost livelihoods, destroyed infrastructures, harmed natural resources, and forced the displacement of numerous people. Recent rainfall in the southern Philippines led to flooding and landslides that resulted in fatalities as well as estimated 1.36 billion peso ($24.4 million) in losses for infrastructure and agriculture.

With an index score of 25.14%, the Philippines placed third among all nations with the highest risks globally in terms of catastrophe risk, based on the World Risk Report 2018 (World Economic Forum, 2018; quoted in the 2019 report of the United Nations for catastrophe Risk Reduction). With some estimates placing 60% of the nation's territory and 74% of the population as subject to various risks, including cyclones, earthquakes, tsunamis, flooding, and landslides, the Philippines is very susceptible to calamities brought on by natural disasters. As a result of powerful cyclones and lots of rain, the Philippines is particularly vulnerable to floods (World Bank Climate Change Knowledge Portal, 2021). Tropical cyclones are linked to landslides and floods. Typhoon Yolanda reportedly caused the biggest damage in 2013, killing 6,300 people and causing P95.5 billion in destruction to infrastructure (Lara, 2020).

Commonly prone to flooding and landslides in the Philippines are Northern Luzon, some parts of the Visayas region like Iloilo, and some parts of Mindanao such as Northern Mindanao and Davao region (Romero, 2016).

But due to prolonged rains brought on by a Low-Pressure Area (LPA), the municipality of Brooke's Point in southern Palawan has recently been vulnerable to floods and landslides. Flooding inundated some homes, causing a loss of P103 million in agriculture and public facilities (Ticke, 2023).

Residents were got trauma by this event, and people were still perplexed about the reasons behind this phenomenon, considering that the municipality is a forested area and seldom visited by typhoons. Many of the residents were shocked by this happening. Many thought this would not occur because Palawan is safe to live in. Speculations and rumors have circulated that this happened because of mining. Some believe it is because of the lack of proper drainage, while others argue that it is because of climate change. Hence, to reveal the truth behind this problem, a study focusing on the causes and impacts of floods and landslides in Brooke's Point should be conducted.

Research Questions

This research paper aims to explore the causes and impacts of floods and landslides in Brooke's Point, Palawan. Specifically, it sought to answer the following questions:

1. What are the causes of floods and landslides in Barangay Brooke's Point, Brooke's Point, Palawan?
2. What are the impacts of floods and landslides among residents of Barangay Barongbarong, Brooke's Point?
3. What do residents of selected barangay in Brooke's Point realize after experiencing floods and landslides?

Methodology

Research Design

This study utilized a mixed-method research design. It can be summarized that research question 1, 2, and 3 follow descriptive quantitative research, while research question 4 falls under qualitative since the answer to the questions were drawn based on the interview with the affected residents. Hence, mixed-method was the fit design in this undertaking.

Respondents

The respondents of this study were residents of Barangay Barongbarong, Brooke's Point, Palawan, who were affected by recent floods and landslides. Specifically, participants were selected from nine sitios within the barangay: Barongbarong Proper, Curanga, Tagusao Highway, Tagusao Shore, Candis, Pintasan, Malulunan, Danadio, and Bagong Sikat. A stratified random sampling technique was utilized to determine the appropriate sample size.

An online sample calculator, Survey System Software, was used to calculate the sample size based on parameter expectations, a confidence level of 95%, and a confidence interval (margin of error) of 5%. Out of 340 affected families, 180 respondents were identified as the desired sample size. To determine the number of respondents for each sitio, a sampling fraction was calculated using the formula n/N (desired sample size divided by the population size). Table 1 presents a summary of the respondents' distribution across each sitio.

Table 1. *Respondents*

Sitio	*No. of Affected Families*	*Sample*
Proper	97	51
Curanga	25	13
Tagusao Highway	39	21
Tagusao Shore	101	54
Candis	44	23
Pintasan	21	11
Malulunan	4	2
Danadio	3	2
Bagong Sikat	6	3
Total	340	180

Table 1 displays the data collected from various sitios, highlighting the number of affected families and the sample size of respondents in each location. In total, 340 families were impacted by the situation being studied, and 180 were chosen as a sample for further analysis. The distribution of the sample reveals the extent of the impact on families in each sitio, providing valuable insight into the situation at hand.

Data Gathering Procedure

The researcher initially obtained permission to conduct the study by submitting a letter to the office of the barangay commander. The questionnaire, which consisted of a checklist and open-ended questions, was disseminated to the selected respondents once it was approved. In order to collect information on the causes and effects of floods and landslides, respondents were given an inventory of prospective causes and effects. Also included in the questionnaire were sections for respondents' demographic information.

Face-to-face interviews were utilized for data acquisition because some respondents were illiterate. Through interviews, the researcher also acquired information about the experiences and realizations of respondents during floods and landslides. Some responses were recorded, and students were also given printed questionnaires to ask their parents about the causes, effects, experiences, and realizations associated with floods and landslides. Interviews and completed questionnaires were utilized to collect data.

Data Gathering Tool

A questionnaire featuring a checklist and open-ended questions was employed, as well as interviews. Two sections made up the questionnaire: Part I focused on the causes and impacts of floods and landslides, allowing respondents to identify the primary factors and consequences in their area, with the option to add additional causes and impacts not listed; Part II featured an open-ended question inquiring about respondents' experiences and realizations related to floods and landslides in their area.

Data Treatment

To address research questions 1 and 2 frequency counts and percentages were used to identify the most common causes and impacts of floods and landslides. For research question 3, thematic analysis was employed to analyze participants' responses.

Limitations and Delimitations

The study had several limitations and delimitations. Firstly, the research focused solely on Barangay Barongbarong, Brooke's Point, Palawan, which may limit the generalizability of the findings to other locations. Secondly, due to time and resource constraints, the study relied on self-reported data from the participants, which may be subject to response biases. However, the use of both questionnaires and interviews aimed to mitigate this limitation by providing multiple avenues for data collection.

Ethical Considerations

The study adhered to ethical guidelines in conducting research with human participants. Before starting the data collection process, the researcher ensured that informed consent was obtained from all participants. Participants were informed about the purpose of the study, how the data would be used, and the voluntary nature of their participation. Additionally, the confidentiality of the participants' information was guaranteed, and any identifying information was removed during the data analysis process to protect their privacy.

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Research Article

Results and Discussion

Causes of floods and landslides in different barangays in Brooke's Point, Palawan

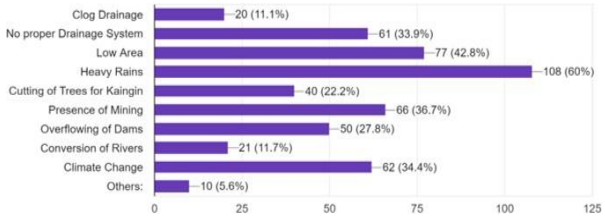

Figure 1. *Causes of Flood*

As shown in Figure 1, respondents agreed that the major causes of floods in their barangay are Heavy rains (60%), Low area (42.8%), Presence of Mining (36.7%), Climate Change (34.4%), No Proper Drainage System (33.9%), etc. It is evident that according to the respondents, heavy rains is the main the reason or cause of wide floods in their area. This finding aligns with previous research that has emphasized the role of heavy rains in causing floods. For instance, Trenberth et al. (2003) found that an increase in extreme precipitation events due to climate change contributes to a higher likelihood of flooding. Furthermore, Alfieri et al. (2015) noted that low-lying areas are more prone to flooding, especially when combined with heavy rainfall and inadequate drainage systems. Additionally, mining activities have been linked to an increased risk of flooding due to landscape changes and the disruption of natural drainage patterns (Kirschbaum et al., 2010). Respondents' perceptions are consistent with existing literature on the causes of flooding, highlighting the need for targeted interventions to address these risk factors in their community.

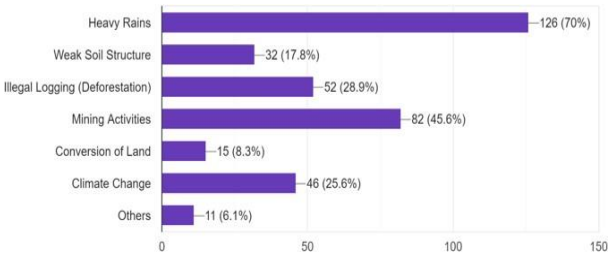

Figure 2. *Causes of landslide*

Meanwhile, Figure 3 illustrates the causes of landslide, it can be inferred that vast majority of the residents agreed that Heavy rains (70%), Mining activities (45.6%), Illegal logging (28.9%), Climate change (25.6%) were the main causes of landslide. These findings suggest that the residents are highly aware of the various factors contributing to landslides in their community. These perceptions are supported by existing literature on the causes of landslides. Heavy rainfall is a well-known trigger for landslides, as it can cause soil saturation and reduced soil strength, leading to slope instability (Guzzetti et al., 2007). Mining activities have also been shown to exacerbate the risk of landslides by altering the natural landscape and weakening slope stability (Petley, 2012). Furthermore, illegal logging can increase landslide susceptibility by removing vegetation that helps to maintain slope stability and reduce erosion (Sidle et al., 2006). Lastly, climate change has been linked to increased landslide occurrence due to more frequent extreme weather events and altered precipitation patterns (Nadim et al., 2006). The residents' perceptions of landslide causes align with established scientific knowledge, underscoring the importance of addressing these factors in order to mitigate landslide risks in their community.

Impacts of floods and landslides on residents of affected barangay in Brooke's Point

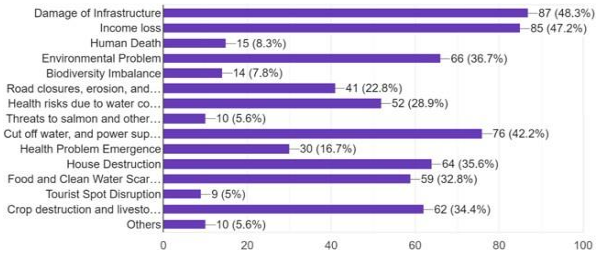

Figure 3. *Impacts of floods*

Based on the responses of the respondents, as shown in Figure 3, the impacts of floods were mainly focused on damage to infrastructure (48.3%), Income loss (47.2%), cut-off water and power supply, and communication systems (42.2%). These findings highlight the various ways floods can disrupt the lives of residents and affect the overall well-being of the community. The reported impacts align with the existing literature on the consequences of flooding. Damage to infrastructure is a common outcome of floods, as inundation can weaken structures and cause physical harm to buildings, roads, and other public and private infrastructure (Kreibich et al., 2017). Income loss is another well-documented consequence of floods, as they can disrupt economic activities, lead to

job loss, and affect livelihoods, particularly in areas that are heavily reliant on agriculture and other flood-sensitive sectors (Hallegatte et al., 2016). Lastly, the disruption of essential services such as water and power supply and communication systems is a critical impact of floods, as it can exacerbate the effects of the disaster and hinder emergency response and recovery efforts (Villarini et al., 2014). The residents' responses regarding the impacts of floods on their community are consistent with established knowledge on the consequences of flooding, emphasizing the need for effective flood management and mitigation measures.

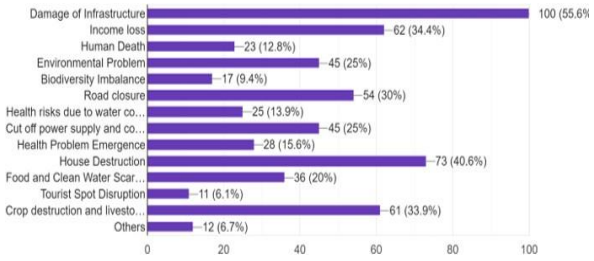

Figure 4. *Impacts of landslide*

Figure 4 illustrates the impacts of landslides on the residents. According to them, damage to infrastructure (55.6%), house destruction (40.6), Income loss (34.4%), crop destruction and livestock loss (33.9%), and road closure (30%) are the most common effect of landslides. These reported impacts are consistent with the literature on the consequences of landslides. Damage to infrastructure and house destruction are well-known outcomes of landslides, as they can cause significant harm to buildings, roads, and other infrastructure (Corominas et al., 2014). Income loss can result from landslides, as they can disrupt economic activities, leading to job loss and affecting livelihoods, particularly in areas dependent on agriculture and other landslide-sensitive sectors (Sidle & Ochiai, 2006). Crop destruction and livestock loss are also frequently reported impacts of landslides, as they can lead to reduced agricultural productivity and threaten food security (Nadim et al., 2006). Lastly, road closures due to landslides can hinder transportation, disrupt essential services, and impede emergency response and recovery efforts (Petley, 2012). The residents' responses regarding the impacts of landslides on their community align with established knowledge on the consequences of landslides, emphasizing the need for effective landslide risk management and mitigation measures.

Residents and government officials of Brooke's Point realize after experiencing floods and landslides

Experience of the Residents during Floods and Landslides

Theme 1: Trauma and Shock. Since it was the first time of the residents of Brooke's Point to experience floods and landslides, many of them have experience trauma, got feared, scared, and worried. Even little rains make them panic, thinking that huge volumes of water will reach their homes again. They narrated that they never expected that these phenomena will come and changed their lives forever. They also added that these events have caused them to fear and worried about their safety because they were trapped and stuck at their houses. Here are some of the experiences shared by some residents:

"We were scared because the level of water got higher and higher" Respondent No. 5
"Most people in our barangay had trauma, and some of us got sick after the flood." Respondent No. 19
"I can still remember seeing the floods raging in our house, and this made me sad, scared, and nervous every time it rained." Respondent No. 36

Theme 2: Destruction of Properties and Livestock. The occurrence of floods and landslides also resulted in the destruction of personal properties of the people, such as their houses, furniture, appliances, and gadgets. In addition, rice fields or palayan, coconut tree, banana, and other crops were also destroyed. Furthermore, farmers have lost many livestock animals, such as their chickens, pigs, cow, etc.

"Our house, furniture, and livestock got destroyed and killed because of severe flooding in our barangay." Respondent No. 1
"The flooding and landslides in our barangay cause a lot of damages, the other houses got broken, their palayan and some of their main source of income got flashed by the flood". Respondent No. 3
"Unexpected flood caused us trauma. It damaged our properties and source of income like coconut trees & banana trees." Respondent No. 4

Theme 3: Availability of Food, Clean Water, and Power Outage. Like other calamities that hit our country, the unprecedented natural phenomenon always resorted in scarcity of food, access to clean water, and power outage failure of communication systems. Many of the residents spent their nights

without lights in their homes and were unable to be reached due to no signal in their places. Due to floods and landslides, some were stuck and could not get out to buy food and fetch water.

"It was difficult to get food because of the height of the flood." Respondent No. 9
"We experienced water and electric outage the whole week." Respondent No. 16
"We run out of water source and run-out of electricity." Respondent No. 37

Realization of the Residents after the Floods and Landslide

Theme 1: Drainage. Aside from heavy rains, many also believed that having no proper drainage system in the streets worsened the flood. Water from the higher area was stuck in low-lying places like barangay Barongbarong. Hence, the residents call the barangay officials to act on this matter.

"We realize that our barangay has no proper drainage system and our place is at a low area." Respondent No.1
"A proper drainage system should be created to prevent flooding." Respondent No.3
"I have realized that a proper drainage system is needed in a community." Respondent No. 15

Theme 2: Be Ready and Prepared. From the experienced that residents have shared, the majority of them had explained that they were not ready and prepared when the floods and landslides came. These resulted in the destruction of personal documents, houses, appliances, crop lost, and death of livestock.

"Expect the unexpected. Always prepare yourself. Know what to save first." Respondent No. 10
"I realized that one should always be prepared in times of disaster." Respondent No. 11
"What I have realized is that you should always be prepared for such situations, so as not to be surprised or confused about what needs to be done, and above all, don't panic in order to act correctly." Respondent No. 52

Theme 3: Plant More Trees and Take Care of the Nature/Environment. While Palawan is known to be paradise because of its untouched or virgin mountains, people believed that floods and landslides have happened due to human activities such as cutting of trees and improper disposal of garbage. Residents believe that to prevent these calamities to hit their barangay once more, they must start to plant more tress and be responsible of their waste.

"We need to plant more trees, have better drainage systems and people should learn how to properly dispose their garbage." Respondent No. 12
"Take care of nature, because the Lord did not make it to destroy." Respondent No. 43
"I realized that we need to protect our nature for disaster, we need to plant more trees and don't abuse our environment." Respondent No. 68

Conclusion

(1) The study on the causes and impacts of floods and landslides in Brooke's Point, Palawan, Philippines reveals that the primary causes are heavy rains, low lying areas, mining activities, illegal logging, and climate change. The community's awareness of these factors is supported by existing literature, which emphasizes the importance of addressing these factors to mitigate disaster risks in their area. (2) The impacts of floods and landslides on the residents of Brooke's Point include damage to infrastructure, income loss, crop destruction, livestock loss, and disruption of essential services such as water, power, and communication systems. These impacts are consistent with established knowledge on the consequences of floods and landslides, emphasizing the need for effective management and mitigation measures to reduce their effects on human lives, properties, and the environment. (3) The residents of Brooke's Point have experienced trauma, shock, and loss of properties and livelihoods as a result of floods and landslides. Their realizations after these disasters highlight the importance of proper drainage systems, disaster preparedness, and environmental conservation, such as planting trees and responsible waste management, in preventing and mitigating the impacts of future disasters. (4) The findings of this study can inform disaster risk reduction and management efforts in Brooke's Point, Palawan, and other similar communities. Addressing the identified causes and impacts of floods and landslides through targeted interventions, such as infrastructure improvements, community education, and environmental conservation, can help protect the well-being of residents, enhance resilience, and contribute to the achievement of the UN Sustainable Development Goals.

(1) Implement comprehensive flood and landslide risk management measures: The local government, in

collaboration with relevant stakeholders, should develop and implement a comprehensive risk management plan that addresses the causes of floods and landslides identified by the residents. This plan should include measures such as improving drainage systems, promoting sustainable land use practices, regulating mining activities, and curbing illegal logging. Additionally, the plan should incorporate climate change adaptation strategies to reduce the community's vulnerability to extreme weather events.

(2) Enhance community awareness and preparedness: The local government, NGOs, and community leaders should work together to raise awareness about the causes and impacts of floods and landslides, as well as the importance of disaster preparedness. This can be achieved through community workshops, educational campaigns, and the distribution of information materials. Furthermore, training programs should be conducted to enhance the community's capacity to respond to and recover from floods and landslides, including first aid, search and rescue, and basic survival skills. (3) Strengthen early warning systems and communication networks: The establishment of effective early warning systems and communication networks is crucial in ensuring timely and accurate information dissemination during floods and landslides. The local government should invest in enhancing the existing early warning systems and explore innovative solutions, such as community-based monitoring and mobile-based alerts. Additionally, efforts should be made to improve communication infrastructure, particularly in remote and vulnerable areas, to ensure continuous access to information and communication during disaster events.

(4) Promote environmental conservation and sustainable development: To reduce the risk of floods and landslides in the long term, it is crucial to promote environmental conservation and sustainable development in Brooke's Point, Palawan. This can be achieved through initiatives such as tree planting, reforestation, and habitat restoration, as well as the promotion of eco-friendly practices like waste management and recycling. Furthermore, the local government should ensure that development projects and land use policies align with environmental conservation goals and prioritize the well-being of the community and the ecosystem.

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