

# A STUDY ON VISUAL EVIDENCE AND COMMUNITY INSIGHTS INTO REEF DEGRADATION: A CASE STUDY ON MORAGALLA COASTAL ZONE, SRI LANKA

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**Abstract:** The world is losing its coral reefs and this is posing a threat to its capacity to sustain biodiversity, raise the protection of coastal regions as well as sustaining the community that relies on coral reefs. Coral reef systems are in the process of continuous decline in the Beruwala- Moragalla coastal area in Sri Lanka which has been worsened by human activities like pollution and coral mining. This loss does not only pose a threat to the ecological resilience, but also to livelihoods of the local citizens. The current paper will give a detailed account of the present-day state of the environment of the Reef under study, records the observable evidence of degradation, and unites the community attitudes, experiences, and knowledge of such an environmental transformation. The methodology of this qualitative case study involved a lot of photographic documentation, participatory mapping and semi-structured interviews with the different stakeholders. The data were analysed using content and thematic analysis with the support of to record spatial vulnerability and local ecological knowledge. The Moragalla Reef is in a very poor condition and is characterized by a mass coral death, algal bloom and a lot of sedimentation. These observations are supported by community accounts which demonstrate the extreme destabilization of livelihoods through disruption of fish stocks and threats of insecurity due to the disappearance of natural coastal defences. The results noted herein demonstrate the necessity to come up with participatory and integrated coastal management approaches, which encompasses pollution reduction, habitat restoration and community-based management to guarantee the long-term ecological and social sustainability of this significant coastline.

**Keywords:** *Coral Reef Degradation, Community Perceptions, Coastal Communities, Visual Evidence, Beruwala*

## 1. Introduction

The coral reefs are imperative marine ecosystems that provide ecological, economic as well as cultural services. They serve as natural breakwaters, reducing the effects of storm surges and wave energy and prevent vulnerable coastline by erosion. They sustain a rich source of biodiversity, supports fisheries and livelihoods of millions of coastal peoples across the world, and are generally the foundation of marine tourism. Increasing human activities like overfishing, pollution, destructive tourism and climate stress are accelerating the decline of coral reefs worldwide. To comprehend this combined social and ecological threats, a local analysis is necessary that would connect the physical evidence of habitat devastation to the immediate effects on human population and the utilization of resources.

Sri Lanka had a vibrant coral reef systems in the southwest coast in the past, which have sustained local fisheries and tourism, including the Beruwala. There have been chronic poorly managed pressures on these systems. It is recorded that over half of the reefs located in the southwestern and southern coasts have been destroyed through coral mining. The current environmental degradation is also enhanced by continued pressures of the locality, such as waste dumping, land pollution, overfishing and unregulated tourism. Early indications in the study zone apply typical symptoms of collapse, including coral reefs that are in poor condition, algae that is thriving excessively, shrinking fish stocks and erosion of shores. The study of this continuing downward trend offers the important background to the present environmental and community challenges in Moragalla.

### 1.1. BACKGROUND AND CONTEXT

The Beruwala coast has a history of sustaining the rich coral ecosystems, artisanal fisheries and tourism. The Indian Ocean Tsunami that struck the region back in 2004 has caused great geomorphological alterations in the area such as coral colonies destruction, movement of sediment, and a shift in the water dynamic (Inoue et al., 2007). Coral mining, pollution, overfishing and uncontrolled tourism activities are some of the other forces that have enhanced the rate of degradation of the reef. There is an initial observation of discarded coral reefs, algae, diminishing fish stocks and beach erosion. Beruwala is a site that is of critical interest to analytical study due to the collective ecological degradation and indigenous-documented effects.

### 1.2. RESEARCH GAP AND STUDY CONTRIBUTION

While there are no recent, localized studies in the broader literature, this study combines a scientific visual observation of the reefs and a structured analysis of community perceptions. The study's triangulation methodology links environmental deficits with socio-economic hardships, providing an overall framework for local management strategies.

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### 1. 3. RESEARCH AIM AND OBJECTIVES

This is intended to examine visual signs of coral reef degradation and understand community knowledge, perceptions and experiences of reef degradation in Beruwala Moragalla coastal zone.

Research Objectives:

- to document visual evidence of coral reef degradation using photographic and field-based observations.
- to analyze community insights on ecological change, livelihood impacts and reef-related risks.
- to identify key drivers contributing to reef decline in the study area.

### 1.4. SCOPE AND LIMITATIONS

This paper is based on a case study of Moragalla coastal region at Beruwala and investigates the degradation of coral reefs according to the visual evidence and the community perceptions. The research area comprised of field observations, photo-documentation, semi-structured interviews with fishers, residents, tourism professionals and marine experts and participatory mapping based on local knowledge and historical data. Storm season between June and August impeded fieldwork and curbed underwater observation and affected community participation. During the study period, one of the key informants was an old fisher and a foreigner who was a conservationist, and he had experienced death which prevented him to get valuable insights. Also, interviews and community mapping were subjective, which hampered the overall validity of the findings.

## 2. Literature Review

### 2.1. GLOBAL AND LOCAL DRIVERS OF CORAL REEF DEGRADATION

There is unprecedented decline of coral reefs in the world. In the last few decades, the world-wide live coral cover has decreased drastically because of interacting stressors (Good & Bahr, 2021). Some major stressors on a global scale consist of a rise in sea surface temperature and acidification from greenhouse gas emissions, which trigger mass bleaching and reduce calcification. These effects are made worse by local anthropogenic stressors. Reef decline is caused by coastal development, pollution (nutrient runoff, sedimentation), dredging and tourism infrastructure (Sgs & Tmspk, 2018). For example, sediment and nutrient loading from rivers can cause algal overgrowth that smothers corals. Poorly managed tourism and destructive fishing gear physically damage reef structures and deplete fish populations. The cumulative and often synergistic nature of these local stressors means that reefs already weakened by climate change can shift rapidly from coral-dominated to algal-dominated ecosystems (Fazey et al., 2006).

These global and local pressures interact in complex ways. The global analysis by Good and Bahr (2021) notes that “numerous local and global anthropogenic factors, cause significant environmental change” to reefs, and that local impacts can amplify coral bleaching and mortality.

### 2.2. REEF DEGRADATION IN SRI LANKA

Sri Lanka’s coral reefs have been classified among most exploited in the Indian Ocean. In addition to global climate events (bleaching in 1998–2015), Sri Lankan reefs have suffered from extensive local disturbances. Studies report widespread anthropogenic impacts such as blast fishing, cyanide use, illegal coral mining, sedimentation, and pollution from land-based sources. The 2004 Tsunami incident caused severe reef scouring, sediment deposition and physical destruction along Beruwala- Moragalla coast, altering wave dynamics and degrading marine habitats (Inoue et al., 2007). These impacts weakened natural reef protection and accelerated coastal erosion.

Globally, coral reefs are under threat due to rising sea temperatures, pollution, and destructive fishing. In Sri Lanka, coral mining, waste disposal, physical trampling and unregulated visitor flow contribute to major losses in live coral cover (Bailly & Virto, n.d.). “Destructive fishing methods, such as the use of bottom-set nets and blast fishing, continue to damage coral reefs in Sri Lanka” (Ohman et al., 1997). In Sri Lanka, blast fishing is prominent and target reefs and animals whose have links with them. “Including within marine protected areas. Coral mining in the sea has not been stopped even after the tsunami. Various forms of pollution from land-based sources continue to degrade the coastal waters” (Souter & Linden, 2005).

### 2.3. SOCIO-ECONOMIC DEPENDENCE AND LOCAL PERCEPTIONS

Coastal communities rely heavily on the reef resources for food security, income and cultural identity. Coral reefs support fisheries that provide nutrition and livelihoods (Rahman, 2014). They also protect coastlines and sustain tourism-based economies. The local community in the Moragalla comprises a big number of artisanal fishermen and tourism operators whose livelihoods are closely connected to the reef ecosystem. Community perceptions are known in the literature to be significant measures of environmental change. Local people have been observed in studies to spot the reef decline with them even before formal surveys detect it. The involvement of the community in reef research may enhance the data precision and management results. For instance, researchers argue that ecological surveys to be used alongside the stakeholder perceptions should be introduced to guide management (Dinsdale, 2009).

Marine experts interviewed, confirm that the reef in Beruwala which was vibrant in the 1990s is now mostly dead because of cumulative stressors. The inland drains increase inland waste that enhances the growth of algae and smothers the coral fragments (Mudalige, 2025). The findings of the shoreline erosion and deteriorating reefs along with the dwindling fish stocks are routinely reported by communities in the coast. Cultural loss is also being expressed through disappearance of once known reef landscapes by residents. In interviews, individuals explain emotional distress, financial insecurity, and shifting day-to-day practices and they emphasize how environmental degradation directly defines their daily experiences and strengthens their sense of environmental change over time. The spatial knowledge exhibited by residents was in agreement with ecological observations as residents mapped degraded areas, accident-prone areas as well as fishing routes in collaboration with residents.

### 3. Methodology

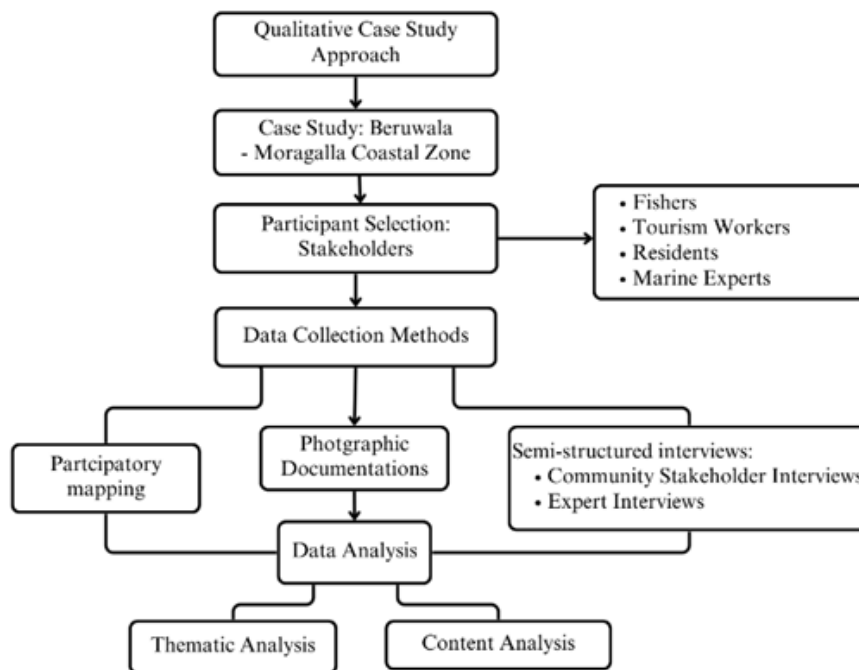


Figure 1 - Methodology

#### 3.1. CASE STUDY AREA AND RESEARCH DESIGN APPROACH

The research took the qualitative case study design where it considers the Moragalla coastal region, which is a highly exploited zone on the southwestern side of the Sri Lanka coast, where there are reef patches, fishing settlements, and a high level of tourist activities. The field-based research design was adopted where a mixed methods approach was applied in order to promote full data triangulation (Figure 1).

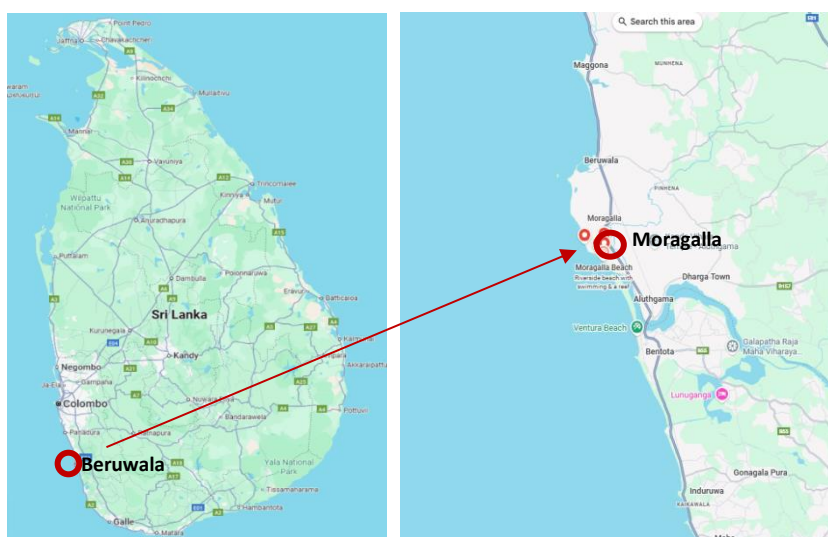


Figure 2 - Location (Source: Google Maps)

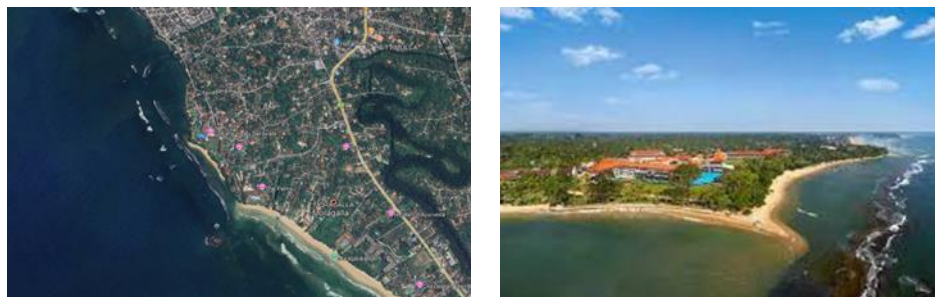


Figure 3 – Moragalla Site Location (Source: Google Maps)

### 3.2. DATA COLLECTION METHODS

Participant selection involved interviewing 30 diverse stakeholders to capture a range of perspectives (Table 1) such as fishers with 10 or more years of experience, long-term residents, tourism workers specializing in reef-based activities and marine experts engaged in ongoing coastal restoration programs. And data collection tools mentioned in Table 2.

Table 1 - Participant Selection Criteria

| Group                  | Criteria   |
|------------------------|--|
| <b>Fishers</b>         | Active for 10+ years; rely on reef-based fishing             |
| <b>Residents</b>       | Living within 500m of coastline; for 10+ years in Community  |
| <b>Tourism workers</b> | Working in reef-based tourism (boats, hotels, guides)        |
| <b>Marine Experts</b>  | Engaged in reef or coastal restoration programs in this area |

Table 2- Data collection tools

| Tool                       | Purpose   | Description  |
|----------------------------|---|--|
| Semi-structured interviews | Capture community perceptions and Expert knowledge on this coastal area | 15–30 min per person; focus on place connection and changes with reef degradation                      |
| Field observation          | Assess physical changes and current conditions in landscape and reef    | Notes and sketches of reef, shore, water, infrastructure and human related activities near coast       |
| Photo documentation        | Visual records of changes and reef condition                            | Reef visibility (Bleached corals, dead reef), beach erosion, Human Activities, pollution, etc.         |
| Participatory mapping      | Capture spatial perception of change                                    | Ask locals and experts (Neighboring communities) to mark degraded/meaningful zones on map of this area |

#### 3.2.1 Photographic Documentation

Evidence of degradation including bleached corals, visible coral breakage and algal growth, Current condition of the coral reef ecosystem, landscape issues, landscape changes, human activities on coastline, solutions used for coastal threats, behavioural responses on stormy seasons and ignored landscape issues. Underwater and above-water photographs were taken at multiple reef locations to visually document degradation. Visual documentation confirms the extensive bleaching and fragmentation of corals along the shoreline and submerged reef platforms, illustrating a loss of natural reef complexity and biodiversity essential for ecosystem functioning.



Figure 4 - Evidence of degradation of the reef of Beruwala Cinnamon Bay area (Source: Chathushka N)

#### 3.2.2 Semi-structured Interviews

Semi-structured interviews, lasting 15-30 minutes per person, were conducted with selected stakeholders. Discussions focused on participants' connection to place, perceived ecological changes, livelihood disruptions, storm-season

experiences, biodiversity loss and community recommendations. This approach was meant to capture emotional, cultural and functional aspects of coastal change, response to reef degradation.

### 3.2.3 Participatory Mapping

Respondents were requested to work together and locate, mark damaged reef zones, fishing tradition areas, erosion boats, wave-surge risk zones and culturally important sites and pollution-infected zones on paper maps of study area. These mapped perceptions provided a crucial spatial understanding of community vulnerabilities and priorities, demonstrating local knowledge aligned with observed ecological conditions.

## 3.3. DATA ANALYSIS METHODS

### 3.3.1 Thematic Analysis for Semi-structured Interviews

Thematic analysis was conducted on interview transcripts and field notes to identify recurring patterns, meanings, and sentiments within participants' narratives. Data were coded using both deductive categories, derived from research objectives, and inductive codes that emerged directly from the participants' stories. This method was critical for interpreting how local people understand, experience, and respond to the ecological decline.

### 3.3.2 Content Analysis for Photographic Documentation and Participatory Mapping

Content analysis was applied to evaluate the visual and spatial data. The photographic analysis and Participatory mapping analysis conducted through content analysis to evaluate visual and spatial data, with proving the reef degradation, factors effect on corals dead, coastal threats due to reef degradation, community activities and restoration projects conducted in this area, its impacts and environmental damages cause for reef degradation in study area.

## 4. Results and Discussions

### 4.1 ECOLOGICAL FINDINGS

Field photographic evidence showed extensive coral bleaching, mortality and reef fragmentation. Algal mats increasingly dominated the benthic surface, indicating ecosystem imbalance and reduction of herbivorous fish. Sediment deposition and coastal runoff further smothered coral beds. A significant decrease in fish diversity and abundance was recorded, affecting local fisheries. Shoreline erosion intensified due to weakened reef barriers, leading to greater wave energy reaching the coast.

Photographic evidence and expert reports indicate that the original living reef is largely dead; the remaining living coral has largely been grafted following restoration activities. Field photographs show algae dominance and exposed coral skeletons. Altered coastal morphology and erosion associated with reef loss. Full credits for the photographs goes to Senior Marine Researcher Chathushka Nadeniya.

- Evidence of Coral reef Degradation



Figure 5 – Dead reef and bleached coral fragments near Cinnamon Bay area, Moragal-la

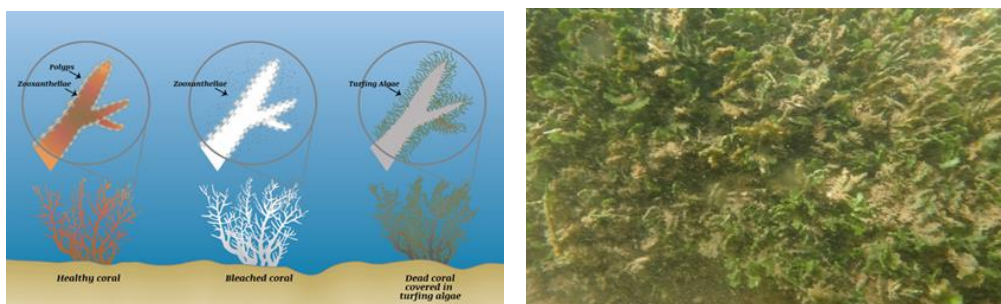


Figure 6 – Process of Coral Bleaching (Blue Corner marine research and Conservation project)

Figure 7 – Algae grown reef in study area

- Current condition of the reef



Figure 8 – Degradation Visible at low tide in the reef (Source – Tripadvisor, Google)

- Landscape issues with beach erosion



Figure 9 - Coastal erosion due to Natural impacts



Figure 10 -Coastal Erosion due to human activities

- Human Activities on the site



Figure 11 - Daily livelihood with Fishing industry

- Active Coral restoration efforts conduct near Cinnamon Bay area, Moragalla



Figure 12 – Ongoing Restoration project

- Results of Anthropogenic activities

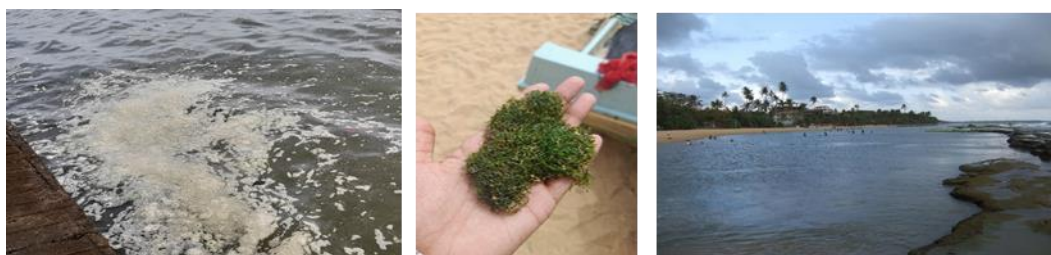


Figure 13 – due to anthropogenic stressors, broken seagrasses and Polluted areas can visible

- Accident prone areas



Figure 14 - The dangerous areas Marked with red flags in land and in the sea near reef edges

- Seasonal Changes near the Shore with sand deposition



Figure 15 - In stormy seasons, Reef edges of this area with sand deposition  
(Source - Google earth in 2019 & 2025)

## 4.2 COMMUNITY INSIGHTS

### 4.2.1 Livelihood Disruption

The views of communities outline severe effects of everyday life. Fishermen have said that now the depletion of near shore fish require a 25 or more miles offshore run and this has drastically escalated the cost of operations, time and risks to safety. According to them, the once-abundant fishing fields now produce garbage rather than fish, which indicates the extent of pollution and collapse of resources. The community and tourism employees were concerned with the change in beaches and tourism operators mentioned a decrease in the number of visitors because of poor aesthetics of reefs and turbidity of water, which affected the potential of tourism business. Community stories emphasize the emotional attachment and livelihoods that environmental degradation has broken.

### 4.2.2 Safety Concerns

The participants clearly indicated safety issues that were associated with reef collapse and they observed erratic waves and development of zones where risks of accidents were prone. This exhibited spatial information on how the damaged reef structure fails to reduce the wave energy. The need to have better risk communication and hazard demarcation in cases of storms was necessitated by communities (Figure 14).

## 4.3. FINDINGS FROM PARTICIPATORY MAPPING ANALYSIS

### 4.3.1 Spatial Distribution of Degraded and Hazard-Prone Areas

The community members correctly recognized erosion fronts, narrow shoreline and high-risk areas, which validated the fact that there was a direct spatial correlation between the loss of coral reefs and increased coastal erosion (Figure 16, Figure 17). The knowledge of local people to highlight hazards in the waters near the reef edges (Figure 18) will give site specific information which is essential in effective management intervention.



Figure 16 - Coral reef degraded areas



Figure 17 - Shoreline Eroded areas



Figure 18 - Accident Prone areas

#### 4.3.2 Spatial Patterns of Human Use and Coastal Activities

The spatial analysis has indicated a major overlap between the highly utilized areas i.e. fishing grounds, bathing areas and tourism areas and the worst degraded areas of the reef and shoreline (Figures 19, 20). This has been corroborated by this overlapping vulnerability which affirms the direct human susceptibility to ecological deterioration. In addition, the mapping recorded the current community-based initiatives, including the coral restoration efforts around the Cinnamon Bay, which indicate local adaptive capacity (Figure 21).



Figure 19 – Recreational areas including sea bathing, surfing, fishing



Figure 20 – Fish catching and unregulated tourism

#### 4.3.3 Community Actions, Conservation Priorities and Adaptive Spaces

Through local management initiatives like mangrove planting and coral monitoring, which entail scientific recovery along with community-led governance to organize the coastal management, there is a growing resilience and a sense of teamwork.



Figure 21 – Coral Restored area

#### 4.4. DISCUSSION

This research indicates that the degradation of the coral reefs in the Beruwala Moragalla coastal area is caused by cumulative ecological pressure and human pressure. Ecological conditions were extremely poor, as the observations of the sea revealed widespread coral destruction, algae growth, sediments, and the decline of the populations of reef fish. These results are consistent with the international trends of coral deterioration, and they draw attention to the local issues that local human activity causes. Ecological evidence was supported by the community views. Fishermen always said that they caught fewer fish and had to go farther out to sea thus adding to their exposure and expenditures. According to the tourism workers, the reef lost its aesthetic worth and there were the concerns that the interest in the reef and the revenues received by the workers would reduce. The local population showed concern about the reef destruction and associated with the overall environmental problem such as water contamination and beach erosion.

Combining ecological analysis with community experience was useful in supporting the indicators of degradation and the socio-economic impacts. These results combined stress the necessity of reef management techniques that incorporate ecological tracking, pollution control, and active restoration measures along with local involvement and education. This paper records the poor condition of the coral reef in Beruwal based on field observation, photographs and perception of people. Results indicate that there is great loss of corals, algal dominance, sedimentary and disappearance of fish and the local people are aware of all these changes. The study highlights the significance of participatory reef management plans that include the ecological and social dimensions in order to ensure the sustainability of the biodiversity as well as the resilience of any community.

## 5. Conclusion

The paper has established that the Moragalla coastal reef system is experiencing chronic, severe degradation as demonstrated by the naked eye signs of an ecological crisis, and the consistent and strong community reports of social-economic crises. The high alignment of ecological observations and community stories attest to the interdependence of ecological decline and socio-cultural influences that confirm the effectiveness of the integrated research approach to complex coastal areas.

The significance of the given research can hardly be overestimated: the given work pre offers a critical and decisive socio-ecological substratum of the Moragalla coastal area, which assertively proves that the ongoing ineffectiveness of centralized conservation initiatives has human, quantifiable, costs. It confirms that to achieve immediate reinstatement of coastal resilience, integrated management approaches that allow dealing with both the pervasive ecological stress factors and the consequent community vulnerability at the same time are needed. The combined approach is a generalizable framework of evaluating the socio-ecological vulnerability in other high-risk coastal areas in Sri Lanka and offers policy makers the requisite localized data to focus its resources on preserving its existence and encouraging community resilience. Importantly, the future research should boldly shift its emphasis out of the reporting decline on the one hand, and to active, practical intervention and sophisticated governance exploration, on the other. Intervention Science and Resilience Enhancement: Applied research needs to be cantered on the effectiveness and scalability of active ecological engineering. These involve planned, large scale research to test new intervention programs to increase the coral population resilience like selective breeding of thermal and disease resistance. Moreover, the recovery rates, the recovery of fish biodiversity, and the effectiveness of the structural complexity contribution to the coastal protection should be quantified by running extended evaluation of the current community-led restoration projects that should be conducted.

Advanced Monitoring and Governance Future work must utilize methods of high accuracy and repeatability to monitor recovery, as well as to guide resource distribution, by measuring change in reef structural complexity by use of such high-precision repeatable methods as 4D photogrammetry. To understand the institutional and policy obstacles ensuring continued existence of confirmed sources of chronic pollution (e.g., Beruwala Harbour effluent), governance research is crucial to limit the further deterioration of the current and future restoration.

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