The disaster resolving on tourism settlements in small islands

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Abstract. The increasing number of tourists visiting small islands has directly affected the development of low-income settlements spontaneously to support the tourists’ accommodation, but the development itself has, at the same time, ignored the humanistic environment. Several of cities in Indonesia belong to the high-risk index of disasters, including Samalona Island of Makassar City. Therefore, the planning components to resolving disasters on tourism settlements in small islands are needed as follows: 1) identifying the role of elements in the natural mitigation and in the artificially structural mitigation that is available, and the role of local residents to overcome disasters in the coastline of small islands, 2) analyzing the condition of abrasion disasters like storms, gale, and flood tides towards the houses, gazebos, and stalls in small islands. In order to achieve the purpose, the collected data come from the observations, sketches, and direct interviews with the local people owning the houses, gazebos, or stalls. The analysis with sustainable approaches is to reach the development of small island destinations that are safe, comfortable, environmentally friendly, and able to increase the incomes of the local residents. The results of the research describe several mitigation elements in small islands such as the local vegetation with tree trunk diameter is 1.5-2.0m and the branching system covers 80% of the island area. The coastal areas have no more natural mitigation elements to block gales, wave pressures, and tides. However, the roles of society can be seen in the existence of structural mitigation elements such as locally wooden breakest water conventionally made. The condition of abrasion disasters and gales can be found by the changes of beach sand shape not parallel with the seasons, the site of houses, gazebos, and stalls that are always moved in safe locations temporarily. The planning components to resolving disasters in tourism settlements of small islands are landscape recoveries (vegetation replanting) on disaster-prone locations (gales and abrasions) for the settlements in coastlines, building the sea embankment that has double functions (breakwaters and pedestrian ways), and displacing the houses that are suitable with wind intensity and building height (landed houses or elevated houses).

1. Introduction

The Indonesia’s coastline areas and small islands commonly have very potential beaches to do either active or passive tourism activities for citizens. Currently, these potential beaches have become the objects of increasing local income and opening job vacancies, one of them is the development of tourism destination. However, most of the land areas in this location have been occupied or owned by the local people from generation to generation. On the other hand, several of cities in Indonesia belong to the high risk index of disasters, including one of those potential beaches: Samalona Island of Makassar City.

The increasing number of populations in small islands has widely ignored a safe development process against disasters, ±52.0% of residential lease for supporting coastal tourism are built on the
The development of coastal areas is one of the favorable economic sectors for citizens and the surrounding areas. However, the coastal areas with a high concentration of tourists can potentially be a catastrophic disaster, and this situation can result in a mortality rise and an asset loss [4]. The following problems of coastal tourism development are damaging the natural coastal vegetation, providing the tourist access to seas, using the uncoordinated lands, and owning the non-mandatory lands. The focus on tourism industry for the economic growth can potentially undermine the sustainability of tourism sector [4]. Therefore, the development of coastal areas should also provide an integrated plan for small islands by providing special funds for managing the environments in order that hazardous disasters can be reduced.

The disasters to threaten housings in small islands can be induced by the extremely natural phenomena like gales, abrasions, wave pressures, earthquakes, destabilizations of soil, and alterations of sediment circulation. These disasters can induce a serious damage of buildings, infrastructure, and environments, can threaten the inhabitants’ lives, can lose their properties, and can disturb their way of living (Social Department of Republic of Indonesia 2004). Often, the tourism furniture located in coastal areas and in flooding lands is ecologically sensitive and biophysically vulnerable. The development should emphasize the beauty of the coastal environments and the short range to reach the seas [1].

The communities are the fist lines of response to events of a localized nature and have the potential to better recognize and address disaster risk and to handle these risks in their respective habitats [5]. This is similar to the condition of some of the small islands in Indonesia, which is the local people live informally in the islands and they manage the coastal tourism conventionally [1]. The society condition living in coastal areas need a precise management since there can be found a complexity of the coastal area system. The model of coastal area management based on marine tourism and managed
by the local people can give a great economic benefit, but there are three factors of coastal area management that should be implemented and integrated into the ecological beaches, they are utility factors, maintaining factors, and preventive factors [6]. The utility of coastal areas of urban beaches and small islands should priorities the mitigation elements and the environmental sustainability. The activities of space utility should consider the supporting ability of space capacity and suitability (supply) toward the room necessity (demand). The optimum activities of utility consider various potencies from the planning elements of coastal areas of urban beaches and small islands in order to be able to avoid conflicts among the space functions.

The weakness in a space control and the policy application of a weak land owning toward coastal space of urban beaches and small islands can be a factor that stimulates housing growth and most populated settlement that is bumpy and rather slummy [7]. As a result, the space area is not worthily visited, occupied, and invested.

The various aspects related to environments and activities to utilize the resources of coastal areas and small island should be managed as follows: 1) Biophysical environments, 2) Biota dan Vegetation (mangrove and coral reefs), 3) Socioeconomic (population and skills, institutions and laws, economic activities and developments), 4) Infrastructure (piers and harbors), 5) Economic activities (tourism, productive mangrove forest, fisheries, cultivation and fishing, and gas and oil industry’s), 6) Natural disasters (beach erosions, gales, high tides, earthquakes, tsunami, and floods) [8]. The mitigation of natural disasters in coastal areas and small islands can be conducted by three ways:

- Proactive ways; developing physical elements of beach that can directly mitigate and block the natural process (disasters) in the future,
- Adaptive ways; adjusting the coastal management to the future natural changing,
- Retreat/ Do nothing; Following the dynamically natural process to take place, letting the natural process do their actions, and conducting some actions based on the currently natural process.

The mitigation policies of natural disasters in Indonesia follow the bases: 1) Togetherness and Volunteering; 2) Preventive and Curative; 3) Coordination, Continuity, and Integration; 4) Independence; 5) Fast and Precise; 6) Priority; 7) Alertness; and 8) Universality.

The plans for resolving disasters need to be preceded by identifying the housing and capability resources of structure and construction [9]. The mitigation plans need to conduct a projected analysis of housing necessity and an alternative analysis of its solutions. Various private and formal stakeholders and non-profit private sectors can participate in giving advice and guidance to resolve disasters on settlements in small islands, like providing typical programs and innovative technologies for buildings and environments, and making sure of owning the lands legally.

The reduction of beach disaster risks needs to be supported by public sectors’ roles in determining the type and location of coastal tourism development and the increased investment in mitigation [4]. Due to the right handling, the reduction of risks can save up to 90%. The plans for resolving disasters require an integration with constraints and opportunities of social, economic, and local culture characteristics (the culture of small islands) as well as the environmental conditions.

The accommodation approach enables the local population to occupy vulnerable coastal areas with community education; 1) Inform to use of hazard and risk mapping, 2) Construct cyclone building standards that are vulnerable to gales and wave pressures [1] [4].

In addition, the retreat approaches should be considered as the post disasters will increase new resilience, like ensuring coastal subdivision above storm surge level, designing suitable building techniques, application of a tsunami warning system, and designated evacuation routes [4].

3. Method
The research location is concentrated in the coastal area of Samalona Island which is potential beach tourism, located about 7 km from Makassar’s coastline and about 30-45 minutes’ arrival by boats (figure 1). Samalona Island is one of the twelve islands located in the region of Spermonde islands and it also belongs to the Regional Development of Makassar City V (WP). The island is directed to enhance tourism activities and to increase the quality lives of fishermen’s society via tourism activities RT/RW of Makassar City 2015-2034). Samalona Island is now inhabited and managed by the local people there.
The disaster mitigation data toward housing are obtained by direct interviews of all the family heads (saturated sample: 15 family heads) who own houses, gazebos, and stalls to support the tourism activities. Furthermore, the data are taken from observations and physical sketches of house gazebo construction as well as using the documentation (time series) about the history of tides, gales, and wave pressures. The field note is recording all the things found in the research field during the discussion with the stakeholders.

The field research is conducted by a researcher team consisting of three lecturers and supported by six students of Urban Regional Development Department as surveyors: 1) Working Team to interview, 2) Working Team to record and scratch the aspects of housing, settlement, and infrastructure that support tourism, 3) Working Team to record various mitigation elements that take place naturally and structurally in small islands.

![Figure 1. Map of Research Location [11]](image)

The existence and position analyses of elements in the natural mitigation and in the artificially structural mitigation and the analysis of potential hazards toward the quality and safety of tourism zone can be conducted through the study of history in the past (geomorphology) as well as the characteristics analyses of hazards, such as location, intensity, frequency, and probability from sea tides, wind power, gales, waves, and currents. The analysis to designing a concept can be conducted by sustainable approaches in order to reach the development of small island destinations that are safe, comfortable, environmentally friendly, and able to increase the incomes of the local residents (framework of research concept, figure 2).

![Figure 2. Framework of research concept upon resolving disasters on tourism settlements in small Islands](image)
4. Result and Discussion

4.1 Analyzing the role of elements in the natural mitigation and in the artificially structural mitigation as well as the role of local residents to overcome disasters in the coastline of small islands.

The disasters to threaten the housing in small islands may be induced by extremely natural phenomena such as gales, abrasions, wave pressures, earthquakes, etc. The efforts to minimize disasters, especially abrasions, can be in the form of either natural-structural mitigations artificial-structural mitigations [11]. The natural-structural mitigations are actually from the nature without involving men’s hands and the artificial-structural mitigation based on the nature like vegetation is more effective compared to artificial levee. This condition is based on the mitigation elements in small islands such as the local vegetation with tree trunk diameter is 1.5-2.0 m, the branching system covers 80% of the island area. Coastal areas and small have no more natural mitigation elements to block gales, wave pressures, and tides (figure 3).

Figure 3. Photo illustration of vegetation condition in coastal areas and small islands

Samalona Island currently has artificial-structural mitigation elements: a simple levee that is conventionally built by the local residents, private sectors, governments. The shape and construction materials of the levee are closely related to the contractors. There is a typical wooden levee in the island’s west part built by the local people independently to block the sands and waves. This wooden levee consists of assembled woods that look like a fence of ±1.00 m. There are six stone offs ±60 cm diameter and 120 cm high in the island’s south part, there is also a long concrete levee of 40cm wide and ±50 cm–75cm high, built by the external house owners (figure 3). The levee shape is continuous and the levee location is built as needed (figure 3). The roles of society can be seen in the existence of structural mitigation elements such as locally wooden breakest water that is conventionally made.

Figure 4. Photo illustration form various shapes and types of levee to block waves and sands built in coastal areas and small islands
The mitigation pattern conducted uses Togetherness and Volunteering. Hence, the structural mitigation elements are based on the artificial (embankment) and built by protective and adaptive ways to overcome and block abrasions in accordance with the natural changes in the future (figure 4). The wind direction and strong waves (abrasions) cause to change the width, shape, and dimension of small island areas (table 1 and figure 4). The island dimension changes to follow the island’s spatial shape, affected by winds and strong waves as well as the available blocking walls and sands. The seasonal aspects do not significantly affect the changes of island dimension.

### Table 1. The number of Samalona Island’s changing dimensions [10]

| Year   | Month   | Width (ha) |
|--------|---------|------------|
| 2000   | October | 2.95       |
| 2001   | May     | 2.95       |
| 2009   | April   | 2.11       |
| 2011   | November| 2.11       |
| 2012   | October | 2.14       |
| 2013   | August  | 1.91       |
| 2014   | October | 2.22       |
| 2015   | April   | 2.01       |
| 2016   | November| 2.19       |
| 2017   | May     | 2.10       |

4.2 Analyzing the condition of abrasion disasters like storms, gales, and flood tides towards the houses, gazebos, and stalls in small islands.

The small islands’ residents (Samalona Island) generally start to build houses from the center to the side area (Figure 6) and the building development is always the same, which is starting from the central zone: the safest area for the local people. Samalona Island, with a relatively small island dimension (2.14 Ha), has reduced its dimension and has always changed its shape based on the wind directions and sea waves, particularly in the last ten years (figure 4).

The house buildings and Bale Bale develop circularly following the island geography. Furthermore, the zone formation is also influenced by sale value aspects that can fulfill the visitors’ comfort to enjoy the beach with a short distance, or that is based on land owning rights by the local residents. All these development patterns have ignored the building safety against winds, tides, and waves pressures. The road patterns and service knots are significantly excluded as the forming factors of space structure in coastal areas of urban beach and small islands. Houses, gazebos, and stalls are excessively built.
without a concept of disaster mitigation. There are 52.0% of rented houses located in a site that is vulnerable to building safety that can be threatened by the winds from Northwest and Northeast.

Figure 6. Photo illustration taken from housing traces developing outside the central zone (safe zone), prior to 1990 there were only nine house units occupied by Dg Rurung’s family [10].

The traces of housing buildings, bale-bale/gazebos, and stalls develop irregularly inside an outer circular zone from the central zone (figure 6). Spatially, the pattern of building traces is formed as a group based on the land owning, family kinship ties, and the trees’ locations (residents are allowed to cut down trees to build houses). The building traces characteristics follow the retreat/ do nothing because of ignoring the development pattern based on either protective or adaptive zone toward the natural process to take place.

Figure 7. Buildings, houses, and bale-bale use vegetation shades in coastal zone and small island

The dominant development patterns follow the space availability based on the land owning and the strategic locations that can give economic benefits from the tourists (e.g. the development either in coastal zone or in an area where trees’ shades are available). In case of one family who owns more than 40 bale-bale due to owning the strategic wide zone but during the northeast wind, the island shape changes, the space availability also reduces, mitigation aspects are ignored, so the houses and gazebos must be relocated or let the natural process do their action, then the allocation is adjusted based on the current condition of natural changes (retreat pattern).

The housing is built as a group. It does not seem to have a strong structure and the building type and the building height are located in a hazardous zone like gales, waves, and tides (table 2). The regional space affected by the winds from Northwest and Northeast is directed to be one-floor
buildings [12]. Currently, there are 24% of two-floor houses (elevated houses) located in a hazardous zone, and most of the elevated houses have space under the houses. The construction shapes of landed houses develop strongly, but this condition is not supported and based by a mitigation study for Samalona Island [12]. However, the sustainably considerable plan should be added, particularly for small islands’ space. Every building cover width <50 m$^2$ should need one water container with 1.5 m$^3$ dimension [13]. There are 52% landed-house types and 16% of two-floor houses with space under the houses. It indicates that 68% of building covers that have lost their water absorption zone in small islands. It can be concluded that the small islands’ zone has lost its 25.5 m$^3$ water absorption zone.

| Building construction shapes         | N | %  |
|--------------------------------------|---|----|
| Elevated houses                      | 8 | 32 |
| Two-floor houses (space under the house is available) | 4 | 16 |
| Landed houses/ ordinary houses       | 13| 52 |
| Numbers                              | 25| 100 |

4.3. Components to Resolving Disasters on Tourism Settlements in Small Islands.

The coastal areas in small islands experience a rapid development of most-populated housing building that can impact on a society’s economic rise as a facility management to support the tourism in the area. This development preservation requires a sustainable planning and management in order to maintain the preservation in the coastal area. The local residents living and managing the coastal zone require an understanding of environmental mitigation ways, so they can support the regional preservation and the building safety. The environmental condition will get more quality if the local residents have a legal status of their lands clearly. The one of the causing factors that make an area become slummy is the unclear status of land owning [14].

![Figure 8](image_url). Location map of components to resolving disasters in small islands (developed form map of Google Earth Image, Access: June, 2017)
Based on the empirical data and mitigation principles, the housings in urban coastal areas and small islands need a revitalization concept that is to renovate the available buildings based on a space that is vulnerable to abrasions, winds, and waves. In addition, the retreat approaches should also be considered since the post disasters will increase a new resilience, like ensuring a coastal subdivision above the storm surge level, designing suitable building techniques, applying a tsunami warning system, and designating evacuation routes.

The required mitigation elements are creating the landscape recoveries (vegetation replanting) on disaster-prone locations (gales and abrasions) for the settlements in coastlines, building the sea embankment that has double functions (breakwaters and pedestrian ways), and displacing the houses that are suitable with wind intensity and building height (landed houses or elevated houses).

The coastline areas should be used as an open space that allocates some activities, like enjoying the scenery, sunbathing, camping, beach sports (beach volleyball, throwing, hiking along the beach), swimming, boating, fishing, diving, snorkeling, and local culture activities.

5. Conclusion

- There are natural mitigation elements like vegetation found in the island with 1.5-2.0m trunk dimension and reaching >20m high and all of these can cover 80% of the island. The artificial-structural mitigation can be either a permanent levee from bricks and concrete or a non-permanent one from wooden fences and sand sacks, or a pole levee. These three kinds of levees are not continuous and not engaged to one another.
- The house buildings, gazebos, and stalls are built in an island zone that is formed by natural mitigations, like vegetation. Thus, gales do not disturb the buildings inside the zone/the island’s central zone while the artificial structural-mitigations are built locally, not continuous, and the levee height dimension is limited to 1,00m. Consequently, abrasions and gales can damage the buildings around the levee.
- One of the components to resolving disasters on tourism settlements in small islands is the revitalization of the available buildings, like regulating the track locations and the height of one-floor buildings of elevated types in order to give water absorption area. Planting trees in the coastline area and building a continuous embankment than can functions as a pedestrian way and a spectator.

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