Planning Model of Disaster Response Buildings and Environment in Coastal Area, West Sulawesi

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Abstract The need for disaster response management in an area gives full attention to the government to issue regulations and policies on the arrangement of land use and buildings against disasters. Indonesia, whose territory is surrounded by water, requires handling, especially for coastal areas that are at risk of potential disasters. In general, the coastal area is the place where fishermen live, which gives the spatial character of the area in the arrangement of a building model and its environment. The need for a place to live forms a group of settlements that make the coastal area dense and land less. The magnitude of the influence of the sea on their livelihoods as fishermen forces them to settle in the area. The purpose of this study is to analyze the spatial planning model for the coastal area by looking at the sustainability of the building layout and environment planning for disaster preparedness and then developing the right model for structuring buildings and their environmental in coastal areas in Majene district. This research uses a qualitative descriptive method that reveals facts in the field and then analyses it with literature studies from various related sources. The main target is a model of building arrangement and its environmental layout in coastal areas with variable indicators including land use and shape, spatial patterns, and building mass arrangement, orientation, and building patterns, circulation and access, community socio-culture, and potential disasters which will be analyzed and then develop models that right for the arrangement of the building and its environment. This group is divide according to several zones then analyzed and presented with tabulated presentation. The sampling technique is based on division of zones arranged by referring to the image map of the area which is the object of research. The results of this research are in the form of planning a building arrangement model and environment in coastal areas and developing a model of buildings arrangement and disaster responsive environment. This research is expected to be a recommendation for the implementation or direction of government policies on the arrangement of coastal spatial areas in general and especially in Majene, West Sulawesi.

Keywords: Planning#1, coastal#2, disaster response#3

1. Introduction

The need for disaster response management in an area gives full attention to the government to issue regulations and policies on structuring land use and buildings against disasters. Indonesian, whose territory is surrounded by water, requires special handling of coastal areas that are at risk of potential disasters. In general, the coastal area is the place where fishermen live, which gives the spatial character of the area in the arrangement of the building model and its environment. The need for a place to live forms a group of settlements which make the coastal area denser and less land. The magnitude of the influence of the sea on their livelihoods as fishermen forces them to settle in the area. The purpose of this study is to analyze the spatial planning model for coastal areas by looking at the suitability of building and environmental arrangements for disaster preparedness and then developing the right model.
for structuring buildings and their environment in coastal areas in Majene district. Human awareness of the importance of safety is needed at all times. One of them is disaster response. Preparedness is an effort in disaster risk reduction that must be carried out from an early age to provide protection and a sense of security for the people where they live. This is reinforced by the existence of regulations concerning disaster as stipulated in the Republic of Indonesia Law Number 24 of 2007 concerning disaster management. Disaster response is important to be implemented in everyday life, especially when residents are about to build houses by taking into account the spatial planning model for buildings and the environment which greatly determines the safety of life and property when a disaster occurs. Natural disasters that often occur throughout the year, especially in coastal areas, include climate influence; which has an impact on monsoons. From February to April there is usually a West monsoon which is very risky to the coastal area, the highest peak is from July to October with the East monsoon gusts which often cause hurricanes. In addition, several disasters that are risky occur in coastal areas, such as floods that result from inadequate environmental sanitation. Therefore, we need an innovative new breakthrough in order to create safety and comfort as a user of coastal space so that the life of coastal communities is still maintained and integrated with nature through the development of an arrangement model in residential areas in coastal areas related to the arrangement of buildings and their environment.

The residential pattern in Ayuninggar (2012) is identified in 4 aspects, namely the physical building, the structure of the living space, the pattern of the space in the house, and the building layout pattern. The shape and pattern of a house can be influenced by its socio-cultural aspects. Model is a representation of several aspects of a real system. According to Ford, modeling is an iterative process through trial and error correction. Models are usually built through complex steps to a precise and dynamic simulation form (Ford, 2009).

2. Literature Review and Methodology

2.1. Arrangement of Disaster Response Residential Environment
According to Sutopo, 2016. Disaster management always develops from time to time. Always dynamic. One place with another different ways of dealing with it. Disasters become a common affair. The government and local governments are the main responsibility. whereas the word disaster or disaster is a natural or man-made event, sudden or progressive, which causes a devastating (great) impact so that the affected or affected community (society) must respond with extraordinary actions. Meanwhile, the term management of an activity, art, method, style, organization, leadership, control, in controlling or processing activities.

2.2. Disaster Risk Reduction
For arrangements that reduce disaster risk, the main objective is to reduce the impact and destructive force caused by disasters and minimize these impacts both in life and economy.

2.3. Designation of Hazard Areas in Open Space Functions
The main land use planning strategy needs to be considered for the type of designation and allocation of old hazardous disaster areas for agricultural purposes, parks and recreation areas. Development for these areas is carried out to a minimum as a design strategy for the effectiveness of regions that are experiencing development pressure.

2.4. Escape route
Apart from earthquake-resistant buildings, what is also needed in an effort to minimize the impact generated by disasters is planning for evacuation routes for disaster victims. Basically, there are 2 types of evacuation route planning, namely the evacuation route in buildings and the evacuation route in residential areas.
2.5. Evacuation routes in buildings / buildings
Planning for escape routes in buildings / buildings, especially those with floors, is mostly done by making emergency stairs or elevators that can be directly connected to the outside space. Usually the emergency stairs are placed on the side of the building or right in the middle which is the core of the building. This is intended to make access to get out of the building easier and safer.

2.6. Evacuation routes in housing / settlements
The service path planning system / environmental service is a design of the flow of movement of service vehicles (such as garbage carriers, goods carriers, fire engines including ambulances) from a particular neighborhood block or lot, which is mapped to the hierarchy / class of roads in the planning area. This is important because if one day a disaster occurs, as much as possible the rescue vehicle can immediately go to the location to provide assistance.

2.7. Previous research relevant to the title
Title of research, "Coastal Area Typology Study for the Development of Fishermen's Settlement in Menapa, Nunukan ". The research objective was to determine the typology and to compile a strategic economic potential of the fishermen community which is maximally in the coastal fishing area of Mensapa, Nunukan Regency. Using the cluster and spatial analysis stage method. The results showed that the area used the Culdesac Pattern system.

Research, Nurmaidah A, et al., 2015, entitled 'Home Model and Residential Environment Feasible and Disaster Resistant. The case of Saugi Island, Pangkep Regency, South Sulawesi ", aims to develop a disaster-responsive spatial design and architectural design model in the settlement of the Saugi Island area in Pangkep Regency, South Sulawesi. The methodological approach is descriptive qualitative and quantitative. The final product of this research is a model for disaster-responsive spatial and architectural design. Building design models must rely on structural reinforcement and materials to overcome building damage.

The method used in this paper is a qualitative description by collecting data and analyzing the shape of the buildings in the research area, classifying land use and infrastructure then analyzing the influencing factors including land shape, climate and buildings. The discussion aspect as the limitation of this research is the study of the development model of building forms and the environment used which can then be linked to potential disasters. Data can be obtained from comparative literature studies and survey data by conducting interviews, documentation and field data analysis. Taking the sample by dividing the zones based on the image map by analyzing the factual building arrangement in the field and processing the data for the development of the building arrangement model and its environment, the data is analyzed based on the shape of the land, building groups and its social environment which are used to get a more precise building arrangement model as well as being the main factor which affects the relation to the coastal spatial planning model which is then responsive to disasters. The next data will be tabulated in the form of a matrix based on several variables that will be examined to obtain an appropriate design concept for the structuring of buildings and disaster response environment in coastal areas.

3. Discussion

3.1. The Research Location Overview
The research area is located in the Tamo neighborhood, Baurung Village. Based on the geographical location, this village is located at 3 ° 32 '32" LS and 118 ° 58' 28" East Longitude which is in the East BanggaE District. Physically, the geographical condition, the area of Baurung and Labuang sub-districts is located in the coastal area which is based on its altitude above sea level, this area is located at an altitude of 1.2 meters above sea level. Meanwhile, the urban village which is located at an altitude of 1,200 meters above sea level is the village of Buttu Baruga Village.
3.2. Administration and Governance

Based on its geographical position, Banggae Timur District is directly adjacent to Banggae District in the north and Polewali Mandar District in the east, the southern and western boundaries are Majene Bay and Makassar Strait, respectively. The administrative boundaries of East Banggae District are divided into 8 (eight) sub-districts and one village of which is Labuang, North Labuang, Baurung, Lembang, Tande, Tande Timur, Baruga, Baruga Dhua and Butu Baruga villages. The number of local environmental units (SLS) is 43 consisting of 39 neighborhoods and 4 hamlets.

3.3. Social and Cultural Community

Based on data on population density figures in Baurung Village, this is the 3rd most populated sub-district of the sub-districts in East BanggaE sub-district. So that it can be seen that the level of social life of the community towards the marriage rate is quite high. The social life of the people generally tends to socialize in their neighborhood where the majority of work is fishermen, especially in the Tamo neighborhood. They do daily activities in their environment with activities related to their work as fishermen, some of them are gardening. According to BPS, 2019, their kinship system is still strong with the kinship system, where they usually live with their relatives and live close to each other. So that the kinship system is very close to relatives or other people who have been considered relatives. Activities in the environment are usually still carried out by consensus and mutual cooperation with the residents, still applying the old culture which is carried out based on the customs and habits of the elders that have been passed down from generation to generation.

3.4. Land Use Planning in Tamo Fisherman Settlements and Baurung Majene Village Settlements.

The use of land in Baurung Majene Village is used; residential land, garden land, pond, open land, tourism, cemeteries, rocks, TPA and and several facilities in the form of; educational facilities, trade facilities, offices, health care and worship. There are swamps and shrubs and mangroves. In this Baurung village, there is also a small industry, namely the brick industrial area. The following is a map of land use in the fishing settlement area of Tamo and Baurung Village.
3.5. Residential Space Pattern Model at the Research location

The settlement pattern in the Fisherman Settlement area in Tamo, Baurung Village, East Banggae District, there are houses with a rather high density compared to other hamlets in Baurung Village. The residents prefer to live in this area because they find it easy to carry out fishing activities to fulfill their needs.

![Figure 3](image1.jpg)  
(a) House near the facility, (b) adjacent to the sea  
Source: Documentation, 2020.

In this Tamo area, most of the houses follow the existing road patterns so that they form a spatial pattern of settlements following the general roads, but some also do not follow the paths that are located close to each other in the area behind the local residents' houses.

![Figure 4](image2.jpg)  
Figure ground map with Path Pattern  
Source: Analysis, 2020

In this Baurung village, it also has a contoured slope, because some residents live in hilly areas. The difference in land height in the area is about 7-8 meters from the height of the coastal area.

3.6. Potential for disasters in the fishermen settlement area in Baurung Village, East Banggae District.

In general, coastal areas are very vulnerable to natural disasters, including strong winds / tropical winds, floods, and tsunamis. The residents of Baurung Village have experienced strong winds which are usually accompanied by heavy rains at certain times. This incident is most risky to occur in the area of this study which is located in the hamlet of Tamo, Tamo Dhua. Physically, its natural condition is directly adjacent to the beach / sea coast. This natural disaster with strong winds accompanied by heavy rains usually occurs in the months from August to November, the East Monsoon Wind cycle occurs. The magnitude of the ocean waves that occur in this area is influenced by the presence of wind waves and tidal waves. Another impact caused by tidal waves can cause abrasion to slowly erode the shoreline. The Meteorology, Climatology and Geophysics Agency of Majene Regency, West Sulawesi Province, estimates that the wave height in West Sulawesi waters can reach two meters.
3.7. Analysis of Residential Spatial Pattern Model in Tamo, Baurung Village, BanggaE District

Based on the criteria for this group of settlements with consideration of their natural physical conditions and considerations of disasters, it will be divided into 3 Zones of settlement groups, namely; Zone 01 for the settlement of the edge / near the sea, Zone 02 for the settlement near the facility and zone 3 for the settlement area of the hill. Analysis of Fisherman Settlement Patterns in Tamo, Baurung Village, land conditions are a factor that greatly influences the creation of settlements in this area, the proximity of the sea makes residents choose to live in the area considering the ease in their daily activities as fishermen. So that even this settlement pattern is formed around the edge / coastal area. The following is the Analysis Table of settlement patterns based on groups and specific settlements by zone:

| No. | ZONE    | SETTLEMENT PATTERN                                                                 | FACILITIES                          | DISCRPTION                                                                                     |
|-----|---------|------------------------------------------------------------------------------------|-------------------------------------|-----------------------------------------------------------------------------------------------|
| 1.  | ZONE 01.| Linear and random settlement patterns, road patterns have not been formed regularly, houses sometimes follow a linear longitudinal road pattern and some that do not follow the road pattern but lead to the center / facility / settlement facility, so that the pattern will be centered and sometimes layered irregularly. | Not facilities other than settlements. | The land area is bordered by the beach / sea and Zone 02 and some of the land has mangroves around the edge of the sea. The land area is bordered by the edge of the sea / sea and Zone 01 & Zone 03. Some of the land has mangroves around the edge of the sea. |
|     |         | The settlement pattern is formed linearly because it follows a road pattern that extends around the coast / sea area and some organic patterns in land areas that are overgrown with vegetation so that the houses are layered houses. Linear settlement patterns follow a road pattern that extends along the edge of the coast / sea and sometimes layered / congregated in areas where there are lots of mangrove trees / mangrove species. | There are settlement facilities in the form of; TPI (Fish Auction Place). | Source: Analysis, 2020                                                                 |
| 2.  | ZONE 02.| Linear and random settlement patterns, road patterns have not been formed regularly, houses sometimes follow a linear longitudinal road pattern and some that do not follow the road pattern but lead to the center / facility / settlement facility, so that the pattern will be centered and sometimes layered irregularly. | There are settlement facilities in the form of; Service Health(Pustu), and mosque (means worship). | Hilly land and borders with zone 02 and zone 01, the height of the hill above the roof of the residents' houses located in zones 2 and 3, a height of ± 7 meters. |
| 3.  | ZONE 03.| The pattern of linear roads around the hills, the settlement pattern is sometimes in groups and and layers, occupying land that is possible to live in, and settlement clusters occur. | There are no facilities other than settlements. |                                                                                                   |
4. Analysis of land use and infrastructure networks in residential areas

The existing spatial arrangement in the fishermen settlement area in Baurung is divided into residential / residential zones, residential facilities, and open spaces (mangrove forests), hilly / garden land zones.

In general, these environmental facilities are located in the middle of residential areas and edges and are surrounded by natural resources. The open zone (mangrove forest) is in the eastern area of the area and in the west there are hills (gardens).

Some residential orientations are well organized following the road pattern, but some are irregular / do not follow the road pattern, usually this is on land that is starting to form around the mangrove trees, residents choose this land to live in because it is side by side with the mangrove trees that grow around it. Some dwellings are oriented to the sea by following the road pattern in the seaside area.

In the border area of the Red line 03 is a residential zone located on a hill and zone 02 is in the middle of a fishing settlement area and zone 01 is a boundary near the coast and sea boundaries. The boundary placement of the fishermen's settlement should be in the zone 02 area. There should be a coastal border in the area.

4.1. Disaster Mitigation Analysis in Settlement Areas in relation to the Settlement Arrangement Development Model.

4.1.1. Disaster Response Land Use Planning

Land use plan for fishermen settlements in Tamo, Baurung will be analyzed based on the security level of the building location and disaster response activities, namely:

(1) In areas that are in the coastal area adjacent to the sea, it can be planned for reforestation with plants with vegetation that can help minimize threats to disasters, for example plants that can reduce wave energy by making embankments that can withstand wave exposure along the coast, which is ± 200 meters. And this land area can later be used as a green open space for the area and open space for the public.

(2) Settlements / dwellings should be divided into 02 settlement zones, namely: Zone I, which has a low building density (directly adjacent to the seashore / beach and follows the border). And Zone II, preferably at an altitude / hill with a disaster response construction system. Required level of construction restrictions on buildings that are outside the boundary.

(3) Placement of public facilities and settlement facilities should be in a safe zone (in the middle of the settlement / settlement center) to facilitate the achievement of all residential settlements.

(4) Maximized for circulation paths that can be connected directly with residential zones for easy access / achievement.

4.1.2. Circulation, Access and Achievement of Disaster Response Settlements in the Tamo settlement, Baurung.

Access and attainment to these settlements, including access from the main road of East Banggae sub-district, to Baurung sub-district via land access, and for island fishermen can go through the jetty point to residential areas, the road pattern is not well organized so that sometimes there are alleys between settlements as access. the outlet is about 2-3 meters wide. Planning this circulation path by considering the threat of disaster. It is planned as follows:

(1) The main circulation should be perpendicular from the direction of the coast to the Safe Zone, wide and direct to the evacuation point in the higher area to facilitate rescue.

(2) For pedestrian access, it must be integrated, making circulation plans for escape routes during a disaster that connect to the main road perpendicular from the direction of the sea to settlements in the safe zone.

(3) Planned horizontal evacuation routes that are easy for residents to reach safer areas when a disaster occurs.
4.1.3. Layout and Building Orientation

Based on the settlement patterns that have been studied previously, it can be seen that settlement patterns are sometimes irregular and some follow an elongated road pattern to form a linear pattern, however, several groups of layered settlements are formed from the presence of aisles between houses, giving the impression of an irregular pattern in this area. These settlements continued to grow to form organic patterns and groups of settlements became dense. The orientation of the building follows the road / circulation pattern and the buildings on the beach generally face the sea following the circulation path that extends to follow the road pattern so that it forms a linear pattern. With this condition, it is necessary to rearrange the layout of buildings that are adaptive to potential disasters. The arrangement planning will be laid out as follows:

1. The settlement pattern that is formed should be arranged regularly following the direction of access, the achievement of tidal wave propagation and the possibility of a Tsunami or perpendicular to the coastline so as to provide space for tidal waves in order to suppress the water discharge is relatively smaller.

2. Planning a settlement pattern with a grid pattern that can provide space / corridors (perpendicular to the coastline), with the environmental road being an access area for tidal wave water circulation.

3. The wide side of the building is made parallel to the coastline so that it reduces water pressure (pasaang waves, tsunamis) and wind (monsoons) hitting the building. The shortest side of the building must be perpendicular to the shore with the orientation of the sea and the circulation path.

4. The settlement location group must be far from the zone most prone to extreme waves, at least 100 meters setback with a radius of > 200 meters from the edge / shoreline.

5. Building orientation takes a reference from the wind direction to determine the orientation of the building. The location of the house which is in the first row from the beach should reduce the openings, because the West / East monsoon winds that come are very strong, especially in areas that lack vegetation.
The orientation of the building affects the shape of the house, because of the amount of wind pressure. So that if the building gets taller, the wind pressure will be greater. The width of the building (not the length) should be perpendicular to the wind to reduce the widest area of the building.

Figure 7. Evacuation route plan against the threat of disaster in the fishermen settlement of Tamo, Baurung.
Source: Analysis, 2020

The building is made parallel to the tidal wave / tsunami wave or perpendicular to the coastline, so that there is less pressure on water and wind hitting the building.

4.1.4. Shape and Mass of Building
It is recorded that in Baurung there are 4941 residents with a building density of around 70%, especially in the coastal area with a distance between buildings of about 1-3 meters, and groups of settlements in the middle area between 2-5 meters. In general, the type of house in the form of a house on stilts has a traditional characteristic that is adaptive to disasters, but many have renovated it by adding space under the house so that this house has turned into a semi-permanent house. As a basis for planning a livable and disaster-resistant house, the guidelines for planning a livable and disaster-resistant house should begin with a residential environmental arrangement then the form of habitable housing and disaster response for fishermen settlements in Tamo, Baurung sub-district is adjusted to SNI 03-1733-2011. Housing can be adjusted to the environmental conditions of the fishermen's settlements on the coast in Tamo, Baurung. So it is better if compilation of data and research analysis is needed which results in:

1. The density of buildings on the coast in Tamo, Baurung is quite high with 60% - 70% built up land, especially in the coastal area with a distance between buildings of ± 1 - 3 m, while the distance between buildings in the central area of the island is between 2 - 5 m.

2. Generally, the houses on the coast in Tamo, Baurung are houses on stilts as a traditional characteristic, and have an adaptive shape to natural disasters.

3. The shape of the house on stilts has been developed in the part under the house, with the general foundation construction being a pedestal foundation with wooden poles resting freely on the concrete.

4. The building materials used in stilt houses generally use light materials such as wood, bamboo, zinc, and palm.

4.2. A disaster-resistant housing model plan in the fishing settlement of Tamo, Baurung, East Banggae District.
Materials used in stilt houses generally use light materials such as wood, bamboo, zinc, and nipah except for houses that have added space under the house (bricks). As a building material, zinc is predominantly used as a roof and wall covering, but the nature of zinc, which is prone to corrosion, is a major problem in homes in this fishing settlement. Zinc is very resistant to rust, especially in the salt beach air. Judging from the type of material used, the condition of the house on stilts in the fishermen's neighborhood is
very susceptible to damage, due to its susceptibility to rust, especially in salt coastal air. There is the influence of an aggressive and destructive coastal climate, especially high winds and tidal waves that can endanger the security and safety of buildings and their occupants.

5. Conclusion
An In the arrangement of buildings and the environment in the fishing area in Tamo sub-district of Baurung, it is still necessary to arrange and direct the buildings and environment by implementing government regulations / policies by observing the condition of the area, environment, culture and social community. There are two policy directions that need to be implemented, namely:
(1) In structuring the building by taking into account the building against the climate that is at risk of disaster and also the shape of the land / contour.
(2) Secondly in environmental management, namely by looking at the physical nature by considering the climate and conditions of the coastal area as well as risk factors for disasters that will occur.

It is hoped that it can become a reference in the guideline for drafting the concept of building and environmental planning concept documents in coastal areas and building and environmental arrangements in Tamo, Majene in particular and coastal areas in general.

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