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IDENTIFICATION OF CONSTRUCTION SYSTEM AND ARRANGEMENT OF BAJO TRIBE SETTLEMENT BASED ON LOCAL WISDOM AND ENVIRONMENTALLY FRIENDLY

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ABSTRACT: This study aims to identify the construction system and strategy of settlement arrangement by literature review and field observation. The results show that the construction system of Bajo house uses simple construction and local material. Column and beams build from mangrove stems. Wall materials are dominant from the woven bamboo blade with plastering. At first, the roof material was dominant from sago palm leaves and now it is dominant from zinc material. The arrangement strategy of Bajo settlement consists of 3 categories: (1) Economic sustainable: developing of home industries, fish sprouts, coastal ecotourism (2) Sustainable Environmental: sustainable waste management, sustainable fishing system, banning of fish bombs, preservation, and reforestation of mangrove. (3) Social sustainable: improvement of infrastructure, utilization of rainwater and solar energy, preservation of local wisdom.

Keywords: Bajo House, Sustainable, Settlement Arrangement, Local Wisdom

1. INTRODUCTION

Indonesia is the largest archipelago in the world covering around 17,504 islands and 5.8 million km2 sea; consist of 0.3 million km2 sea territory and 2.95 million km archipelago territory [1]. The coastal area is one of the mainstays of income source for Indonesian people. The coastal area is a confluence between land and sea areas. They have the potential of marine and fisheries resources, trade potential between regions, islands, and continents so that several countries make coastal areas as a city development area (waterfront city) and trade centers.

The coastal area covers a land area, which is influenced by the characteristics of the sea: wave conditions, tides, and sea winds; while the sea area is affected by natural processes on the sea and human activities such as sedimentation and pollution. Coastal areas are very unique places because of the freshwater and saltwater is mixed in this area. Impact, coastal area is very productive and rich in ecosystems and has a diversity of marine environments, such as mangrove forests, coral reef ecosystems, seaweed, resources marine fisheries. This is the main ecosystem supporting life in the coastal region.

Along with the population growth and the increasing of coastal development such as settlements, fisheries, ports, and tourism objects, the ecological pressure on ecosystems, coastal and marine resources will increase. Consequently, this condition can threaten the existence and sustainability of the ecosystem and resources of the coastal, sea and a small island in surrounding areas.

Coastal areas become one of the large-scale exploitation areas of natural resources because of the natural resources are potential. Over-exploitation of natural resources without the application of sustainable development can damage the coastal ecosystems and a decrease of potential coastal resources. Symptoms of environmental damage can threaten the sustainability of coastal resources, such as pollution, habitat physical degradation, overexploitation, and coastal abrasion [2].

Villages in coastal areas such as fishing villages are the potential to be slum areas with the communities are predominantly poor. The development of settlements in coastal areas causes social, economic, cultural and political problems in society [3]. In the coastal areas of North Maluku there are some floating settlements especially Bajo Tribe Settlement. Their living habits on the water with the economic conditions are to rely solely on their catch as a fisherman, so that, their income is not yet able to sustain a decent life.

Availability of economic, social and cultural facilities such as trade places and local culinary business can support coastal ecotourism-based fishermen settlement functionally [4]. The basic design of the fisherman settlement should consider the house, place, building, path and drainage design, which include adequate houses for fishermen [5].

2. METHODS

This research is qualitative research that emphasizes on the identification of the construction system of Bajo Tribe house (Bajo House) and arrangement of Bajo Tribe settlement (Bajo Settlement), through: (1) Field study: direct observation in the field to obtain primary data directly from the field about the structure and construction of houses, material and typology of houses, (2) Literature review: to complement secondary data information about the strategy of coastal sustainable development, history and lifestyle of Bajo Tribe. (3) Interviews: to obtain information relating to primary and secondary data to supplement data obtained through field and literature studies. Analyses development of Bajo settlements by comparison settlement condition in 2006 with that in 2017.

Fig. 1. Study area in Kayoa District.

3. DISCUSSION

3.1 Characteristics of Bajo House

Bajo Settlements in North Maluku spread across several coastal areas, including Sula Islands, East Halmahera, West Halmahera, and South Halmahera. Bajo Tribe in North Maluku begins to settle in the 1900s, originally an immigrant originating from Sulawesi Island. They sail to the eastern region and tracing the southern islands of North Maluku: Sula Islands, Taliabu, and South Halmahera [6].

The largest Bajo settlements are located in Kayoa District, South Halmahera: Laluin and Posi-posi Villages. Bajo Settlements in Laluin village grow and develop until now by traditionally and culture are still awake. Along with the increasing number of residents of Bajo Tribe, a new settlement is formed in the Territory of Waidoba Island. Furthermore, the development of settlements in this region continues to increase and become a definitive village [6].

a. The condition of Bajo settlement in 2006.

b. The condition of Bajo settlement in 2017.

Fig. 2. Bajo Settlement in Kayoa District.

3.2. The Layout of Bajo House.

1. *Surabi* (Terrace); foyer room, a reception for unofficial guests, this terrace is sometimes used as a place to repair catching equipment.
2. *Tingnga ruma* (Living Room); reception room for official guests, room for a party and traditional events, discussion room.
3. *Tingnga* (Bedroom); family bedroom and children's bedroom with the function is a place to rest (sleep) and as a place to store valuables.
4. *Dapurang* (Kitchen Room); for a cooking room, dining room, and as a place to relax and discuss family members.
5. *Galampa* (Porch); this room is adjacent to a toilet with the function is a warehouse for storage of firewood, fishing equipment, etc.

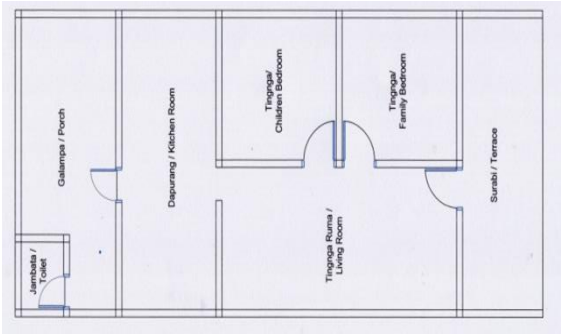

Fig 3. The layout of Bajo house in Kayoa District.

3.2. Construction System of Bajo House

1. *Bente* (Column); the material of the column uses mangrove stems. It consists of 2 types, namely: (1) Main column for supporting beams, floors, roof frame with the high is around 4 meters. (2) The second column for supporting beams and floors of the house with the high is around 1,5 – 2 meters. Both of the columns pierce into the ground of around 50 cm and they use rock as a footing of the column.
2. *Pallangga* (Beams); the beams serve to support the floor and stiffener of the housing column by interconnection system. The material of the column uses mangrove stems and reinforced with wooden pegs.
3. *Dalangang* (Floor); the floor of Bajo house generally uses local material, such as sago palm skin which is crushed flat like a board, small stems of mangrove, planking, and bamboo blades.
4. *Ballak* (Upper Tie-Beam or ring beam); ring beams function to support roof frames and also as a bind of the columns. The material of the ring beam uses mangrove stems and reinforced with wooden pegs.
5. *Dinde* (Wall house); the wall material of the Bajo tribe uses local materials from the surrounding area, such as gaba-gaba (sago palm stem) and timber blade for traditional houses, woven bamboo blade with plastering for semi-permanent houses, and cast wall and brick material. (See figure 4).
6. *Bumbungang* (Roof house); the roof of the Bajo tribe is triangular with the roof frame uses wood or bamboo materials. At first, the roof material uses "katu" or sago palm leaves (see figure 4), but now, generally houses use zinc material and several permanent-houses use a metal roof or multi-roof (See figure 5).

a. Wall material from *gaba-gaba* (sago palm stem) and timber blade.

b. Wall material from the woven bamboo blade with plastering.

c. Wall material from cast wall and brick.

Fig 4. Wall materials of Bajo house.

Fig 5. Roof material of Bajo house.

Figure 6 shows that the models of the house of Bajo Tribe in Kayoa district consist of 3 types: (1) Traditional house: the site is located on the water with the mangrove stems for the column, material wall from bamboo blades, palm leaves for roof material. Several houses use sago palm leave and *gaba-gaba* (sago stem) for wall material (see figure 6a). (2) Semi-permanent house: the site position consists of two types, namely: (a) all of the housing body is located on the water. (b) half of the housing body sits on the rock pile and half of the body is position on the water with the column material from mangrove stems. Material for wall uses wood or bamboo blades, and several houses use cast wall material and bamboo blades as reinforcement. (3) The permanent house uses brick and concrete materials for wall, rock material for footing, the material roof from zinc and multi-roof. A site of the house is located around the main street of the settlements.

a. Traditional house.

b. Semi-permanent house.

c. Permanent house.

Fig 6. Type of Bajo houses.

3.4. The Sustainable Arrangement of Bajo House.

Sustainable development is developed to meet the needs of life today and future generations. The concept of sustainable coastal area management is through a combination of adaptive and integrated development between environmental, economic, social and cultural conservation with a development strategy based on the potential and characteristics of the coast, resources, and needs of the surrounding community.

The management of integrated coastal and marine resources is an approach to managing coastal areas involving two or more ecosystems, resources, and integrated development in order to achieve sustainable coastal development [7]. The declaration of sustainable development in Stockholm 1972-Johannesburg 2002 emphasized the importance of coordination and integration of natural resources, human resources and artificial resources in each national development with a population approach, which is integrated with social, economic and environmental aspects [8-9]. Integrated management is a dynamic and continuous process in the planning of the development, protection, and utilization of marine coastal areas and their natural resources in a sustainable manner[10].

Fig 7. The fisheries potential (fish catch and fish sprouts)

The strategy of sustainable development in Bajo settlements consists of 3 categories:

(1) Economic sustainable development; sustainable settlement, community-based coastal development, provision of the supply of goods and services continuously, increasing community income by developing home industries, exploitation of renewable natural resources.
(2) Environment sustainable development: realize environmentally-friendly development, realizing a clean environment, sustainable waste management, preservation and protection of ecosystems and natural resources. Avoid over-exploitation of non-renewable natural resources.
(3) Socially sustainable development: realizing social justice and mutual cooperation, providing adequate environmental facilities such as social facilities, health, education, clean water facilities, comfort and safety of communities, preservation of local wisdom.

a. Production of traditional cakes (*sagu*).

b. Marine tourism potential.

Fig 8. The potential additional business.

To achieve coastal settlements of sustainable and optimal, there are three aspects as pillars of sustainability, namely: social, economic and environmental aspects. All of these aspects indicate the purpose of sustainable settlement development and also indicate that coastal communities play the main role in development. This concept is in accordance with the concept of a sustainable society, where communities are actors of development, who live within mutually supportive environmental boundaries [11].

In order to improve of environment quality and income of Bajo Tribe, the sustainable arrangement of Bajo settlement in Kayoa District consists of 3 categories: (1) Sustainable Economic: development of household business; drying fish and bloater (*ikan fufu*), making crackers from fish and shrimp, fish sprouts, and cultivation of seaweed (see figure 8). (2) Sustainable Environmental: a system of waste disposal clean, sustainable fishing system: banning of fish bombs, preservation, and reforestation of mangrove, (3) Sustainable social development: preservation of local culture, improvement of infrastructure, utilization of rainwater and solar energy as a solution to the limitations of water and electric energy resources. On the other hand, and additional businesses can be developed for improving their income, such as the home industry for fish canning and making sago cake, dealers of fish, and street vendors (see figure 7). Moreover, Kayoa District has the potential to develop coastal ecotourism, trade places, and local culinary businesses.

Mangrove forests have an important role in blocking the penetration of high-wave of seawater into the mainland area. The study result shows that the mangrove with a thickness of about 200 m, density around 30 trees/100 m^2 and a stem diameter of around 15 cm could reduce the tsunami wave energy of about 50% [12]. Therefore, It is necessary to plant mangrove around the coastline of Bajo tribe settlements.

The existence of the Bajo tribe settlements in the coastal area is determined by the potential of natural resources of the area, namely: potential of settlement; availability of area and local materials for housing construction, potential of coastal resources: it's potential can support lifestyle of the Bajo Tribe on the water, and economic potential: marine resources can sustain their lives and the potential of local business development [13], Mangrove conservation can improve the economic potential of the coastal and marine areas [14]. Thus, the concept of environmental friendly of Bajo Tribe settlements can be developed by integrating sustainable settlement with the sustainable-exploitation of coastal resources, and conservation of the mangrove.

4. CONCLUSIONS

The construction system of Bajo house uses simple construction and local material. Column and beams build from mangrove stems. Wall materials are gaba-gaba (sago palm stem) and timber blade for traditional houses, woven bamboo blades with plastering for semi-permanent houses, and cast wall and brick materials for the permanent

house. At first, the roof material was dominant from sago palm leave and now it is dominant from zinc material.

The potential of sustainable development for Bajo settlements in Kayoa consists of 3 categories: (1) Economic sustainable: developing of home industries, fish sprouts, coastal ecotourism (2) Sustainable Environmental: sustainable waste management, sustainable fishing system, banning of fish bombs, preservation, and reforestation of mangrove. (3) Social sustainable: improvement of infrastructure, utilization of rainwater and solar energy, preservation of local wisdom.

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