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The existence of a mangrove ecosystem as nature tourism-based on global warming mitigation in Lakkang island

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Abstract. As conservation areas, Lakkang Island has a potential mangrove forest. However, there are dramatic decreases of mangrove areas because human activities which are modified the mangrove areas into settlement, embankment, farmland, and farm. Many researchers found that mangrove possesses several benefits for global warming mitigation, yet mangrove lacks unattended. The study aims to analyze the mangrove areas that have been reduced and given impact to diminish CO₂ absorption and to analyze the revitalization strategy of the mangrove ecosystem. Spatial analysis (GIS) is used to illustrate the reduction of mangrove areas, and SWOT analysis (EFAS & IFAS) is used to receive the revitalization strategy. The result of purpose, 14,24 percent or 3 hectares mangrove area were transforming. Approximately 3.600 ton of CO₂ is not absorption. The revitalization strategies are raised to participate of the local community through the comprehension of mitigation function that arises a local environmental quality and global environmental quality, increased government participation and private participation to build facilities and infrastructures, mangrove areas enable to ecotourism that can grow the economy and the life quality for the local community.

1. Introduction

Global warming is now a major environmental issue because it has a huge impact on the world and the life of living creatures that inhabit it, namely climate change and sea level rise. Increasing the concentration of carbon dioxide (CO₂) in the atmosphere is one of the biggest causes of global warming [1]. One of the impacts of global warming is reducing the quality of the environment with reduced of the forest. One of the unique forest plant species is mangrove forest. Mangrove ecosystem is an ecosystem located in coastal areas that are affected by tidal sea water so the floors are always inundated [2]. Mangrove ecosystems support various ecosystem services along the coastline of the tropical region and have an important role to the total carbon value and mangrove stands, through the process of photosynthesis of mangrove plants to absorb carbon dioxide from the atmosphere converted into organic carbon in the form of biomass [3].

The current mangrove forest area in Makassar City is found around the mouth of the Tallo River, especially in the Lakkang city village area. In the development of the Lakkang city village since 2001, the mangrove area constantly has the reduction due to human actions that convert it into cultivated land such as settlements, ponds, rice fields, and gardens. So, since 2013 proclaimed by the government efforts to cultivate the mangroves, but in 2015 and 2017 based on the spatial analysis addition is expected to be insignificant because although cultivation has been done the increase is less than the maximum as expected. Awareness of the importance of mangrove plants as a mitigations plant both to



water pollution and global warming. This study aims to analyze the development of mangrove land on the island of Lakkang from 2001 until 2018 as well as strategies in revitalizing the mangrove ecosystem.

2. Theoretical Approaches

2.1. Mangrove ecosystem

A study on the effects of waste disposal on mangrove communities in Darwin Australia says that mangrove trees have a high capacity to receive waste loads without suffering damage to their growth. The nutrient concentrations attached to mangrove sediments and the high primary production of the mangrove ecosystem indicate that these systems are often deficient of nutrient and have a great ability to hold nutrients. With suitable nutrient inputs, it will be advantageous for the system to be able to stimulate the production of biomass and existing soil formations.

In general, the characteristics of mangrove resources are [4]:

1. Generally grown in intertidal areas of the soils region such as muddy, cloudy or sandy;
2. Flooded by seawater periodically, either daily or only flooded during high tide in the full moon. The frequency of flood determines the composition of mangrove forest vegetation;
3. Receives sufficient fresh water supply from the ground;
4. Protected from strong waves and strong tidal currents;
5. The salinity of the water from brackish to salty.

2.2. Participation forms

According to Keith Davis that forms of community participation are:

1. Thoughts: it is a type of involvement at the first level where participation is using the mind of a person or group aiming to achieve a goal;
2. Energy: it is a type of participation at the second level where the participation is utilizing all personnel owned by groups and individuals to achieve goal;
3. Thoughts and energy: is the type of participation at the third level where the level of participation is done together in a group for reaching the same goal;
4. Expertise: is the type of participation at the fourth level where in that skill becomes the most important element for determining goal;
5. Goods: it is the type of participation at the fifth level in which participation did with stuff to help to achieve the outcome;
6. Money: is the type of participation at the sixth level where the participation uses money as a tool to achieve a goal. Usually, the level of prestige is done by people of the upper class.

2.3. Disaster mitigation

According to Law no. 24 year 2007, disaster is an event or series of events that threaten and disrupt the lives and livelihoods of people caused by both natural and non-natural factors and human factors in the occurrence of human lives, environmental damage, property loss, and psychological impact.

Disaster consists of natural disasters caused by natural events such as earthquakes, tsunamis, volcanoes, floods, droughts, hurricanes, landslides and abrasions. Non-natural disasters in the form of technological failures, failed modernization, epidemics, and disease outbreaks. Non-natural disasters are occurred because of human intervention. Social disaster caused by events or sequences that caused by human events that include social conflicts between groups or between communities, and terror.

Disaster mitigation is an activity that includes disaster prevention, disaster protection and recovery after a disaster. This research is more towards to disaster prevention efforts, because the specific mangrove is growing in coastal areas, it is referred to Law no.27 year 2007 about Management of Coastal Areas and Small Islands are; Disaster Mitigation is an effort to reduce the risk of disaster, either structurally or physically through physical development of natural and/or non-naturally improving the ability to face disaster threat in coastal area and small islands.

2.4. *Ecotourism (nature tourism)*

The understanding of ecotourism experiences from time to time, but in essence ecotourism can be interpreted as a form of tourism that is responsible for the preservation of a natural area, provide economic benefits and maintain cultural integrity for the community. Ecotourism is a form of tourism that is very closely with the principle of conservation. Even in the development of ecotourism also use conservation strategies. So ecotourism is very precise and efficient in maintaining the integrity and authenticity of ecosystems in an area that is still natural. Even with ecotourism, nature conservation can be improved in quality[5].

Coastal marine ecotourism is a tourism based on coastal and marine resources by incorporating aspects of education and interpretation of the natural environment and community culture with the management of coastal and marine ecosystem sustainability. Ecotourism is a tourism activity that has excellent attention to the sustainability of tourism resources [6]. In tourism activities that are responsible for the prosperity of local communities and environmental conservation is highly emphasized as the identity of ecotourism. Same as the opinion that coastal ecotourism is a form of tourism that managed with a sustainable approach where landscape management is directed to the sustainability of coastal and marine resources, the management of community culture is directed to the prosperity of coastal communities and conservation activities directed at the sustainability of coastal resources [7].

A tourist attraction may be exciting to be visited by tourists if eligible for development of the area, such as [8]:

1. What to see, there should be objects and a tourist attraction different from the other regions. In other words, the area should have special attractions and cultural attractions that can be used as "entertainment" for tourists. What to see includes panorama, activities, art and tourist attractions;
2. what to do, in place beside the many that can be seen, must be provided recreational facilities that can make tourists feel at home long stay in that place;
3. what to buy, a tourist destination should have available facilities for shopping especially souvenirs and crafts as souvenirs to be brought back to the origin;
4. what to arrive, includes accessibility, how we arrived at the tourist attraction, what vehicles will be used and how long to the destination of the tour;
5. What to stay, how the tourist will stay a while during their vacation. Required lodging either high-class hotels or non-class hotels etc.

Furthermore, four components must be owned by a tourist attraction that is: attraction, accessibility, amenity and ancillary [9].

1. Attractions the main product of a destination. Attractions related to what to see and what to do. What the tourists can see and do in those destinations. Attractions can be the beauty and uniqueness of nature, the culture of local communities, relics of historical buildings, as well as artificial attractions such as games and entertainment facilities. Attraction must have a high specific value, unique and different from other regions;
2. Accessibility is the means and infrastructure to get to the destination. Highway access, the availability of transportation facilities and signs are an important aspect for a destination. For the ecotourism of Lakkang island, it is needed integrated transportation between land and water. For the individual tourist, public transportation is very important because most of them organize their journey without the help of a travel agent, so it is highly dependent on public facilities;
3. Amenity is any of supporting facilities that can provide the needs and desires of tourists while in the destination. Amenity related to the availability of accommodation facilities to stay, restaurants or food stalls to eat and drink. Other needs that may also be desired and required by tourists, such as toilets, rest areas, parking lots, health clinics, and worship facilities should also be available in a destination. These facilities also need to see and understand the situation and conditions of the destination itself and the needs of tourists. Not all amenity should be adjacent

and located in the main area of destination. Natural destinations and historical heritage should be distant from commercial amenities, such as hotels, restaurants and rest areas;

4. Ancillary deals with the availability of an organization or persons who take care of the destination. This is important because although the destination already has attractions, accessibility, and good amenity if no one manages it in the future will be abandoned. The organization of a destination will do its job like a company. Manage the destination so that it can provide benefits to related such as the government, surrounding communities, tourists, the environment and other stakeholders.

The main principles of ecotourism include [10]:

1. The ecotourism environment should be on a relatively untainted natural and cultural environment;
2. Ecotourism communities should be able to provide direct ecological, social, and economic benefits to local communities;
3. Ecotourism education and experience should improve the understanding of the natural and cultural environment while experiencing impressive experiences;
4. The sustainability of ecotourism should be able to contribute positively to the ecological and environmental sustainability of the activities, non-destructive, non-degrading, both short-term and long-term;
5. Ecotourism management must be managed in a way that ensures the long-term survival of the natural and cultural environment in the area while implementing the best way to manage its economic viability.

3. Methods

3.1. Location and time research

This research was conducted at Lakkang Delta location, located at Lakkang Sub-district, Tallo District of Makassar City. Access to the research location can only use the boat and takes 20 minutes from Kera-Kera dock at Hasanuddin University Campus. This study was conducted in March until June 2018.

3.2. Sample

In conducting SWOT analysis, we need examples to assess and take an opinion about good strategy and suitable for research location. Researchers take samples from the government, community and the NGOs (Non-governmental Organizations) in Makassar specifically Lakkang Village as respondents in answering the content of the questionnaire.

3.3. Data types

Based on the research objectives, the data required in this study are primary data and secondary data. Primary data is in the form of interviews related to the current condition of Lakkang Island and observation by observing directly and analyzing the existing requirements in the research location. Secondary data is data that needed to support the analysis and discussion as supporting research. These secondary data include library research, data or documents from government and spatial data from Google Earth.

3.4. Analysis techniques

The method we use was mapping with GIS (Geographic Information System) for spatial analysis to see mangrove land reduction for 17 years and strategy in revitalizing with EFAS and IFAS of SWOT analysis.

4. Discussion

Administratively Lakkang urban village is located in Tallo sub-district of Makassar City with geographical position located at 05°06'38,2'E and 119°25'37,2'S. Lakkang Village is in the middle of

Makassar City and is a separate area because it has a separate land from the mainland of the city center. This location is surrounded by Tallo River and Pampang River. Lakkang urban village has administrative boundaries in:

1. North area: Kapasa and Parangloe Urban village (Tamalanrea Sub-district);
2. East area: Tamalanrea Indah Urban village (Tamalanrea Sub-district);
3. South area: Pampang Urban village (Panakkukang Sub-district);
4. West area: Rappokalling Urban village (Tallo Sub-district).

The area of the Urban village of Lakkang which is 1.15 km² is the largest area in Tallo District of Makassar City. Lakkang Urban village is a delta or can be called an island surrounded by rivers. Can be accessed from the Kera-kera dock, docks that are connected with historical tourism (Tallo Kingdom Cemetery) located next to the Reformasi and Pampang Toll Road.

In the past Lakkang Urban Village named Bonto Mallanggere which has the meaning of Hearing All Directions, according to story delta, Lakkang was first discovered by Dg. Rilakkang who was a central figure at the time until the Japanese colonial invaders found this delta and made defense bunkers. This area has been designated as a tourist place surrounded by various vegetation.

The number of residents Lakkang Village about 812 people consisting of men as 391 people and women as 421 people. The number of households that live in Lakkang Village is 244 families with an average of 4 people per household with a density of 843 km²/ person.

Lakkang is an urban village or island or delta in Tallo Sub-district, Makassar City, South Sulawesi. Lakkang is located in the delta of Tallo and Pampang river that formed from river sedimentation for hundreds of years. The delta of Lakkang has a characteristic of natural atmosphere. Besides, there some bunker defense of Japanese heritage in the surrounding bamboo trees, and this area is surrounded by mangrove forests and some traditional houses. The condition of the bunker is not maintained and the invasion of houses to the location of the bunker that has been designated as cultural sites.

The diversity of attraction is a natural landscape of the river, Nipah and mangrove forest vegetation, and tourism activities are boating through the river around the delta area and fishing. Regarding socio-cultural potential, Delta Lakkang has unique cultural values with traditional lifestyles and cultural arts activities such as traditional dances and annual post-harvest tradition activities. Based on the observation data can be concluded Lakkang is an urban village that has the potential of nature tourism, history and social culture in the middle of Makassar which should be developed.

4.1. The benefits of mangrove forests as disaster mitigation and its presence in Lakkang urban village year 2001-2018

Mangrove forests are projected to be the main program in reducing carbon emissions in tropical areas with the reason if destroying 1 ha of mangrove forest emissions equal to cutting 3-5 ha of tropical forests (Muhlenberg, 2016). Mangrove forests categorized as wetland ecosystems are capable of storing 800-1200 tons of CO₂/ha, the release of emissions into the air in mangrove forests is smaller than forests on land (Chan Hung Tuck, 2016). Decomposition of mangroves does not release carbon to the air as different as dead tropical forest plants can release 50% of their carbon to the air (Chan Hung Tuck, 2016).

Based on the analysis of mangrove plants in Lakkang sub-district using spatial analysis method from the year 2001 to 2007 has decreased in plant population of 20.82 ha to 17.86 ha. Based on the results obtained by the reduction of mangrove plant in Lakkang urban village from the year 2001 to 2007, the absorption of CO₂ is reduced as 3,600 tons of CO₂ see figure 1.

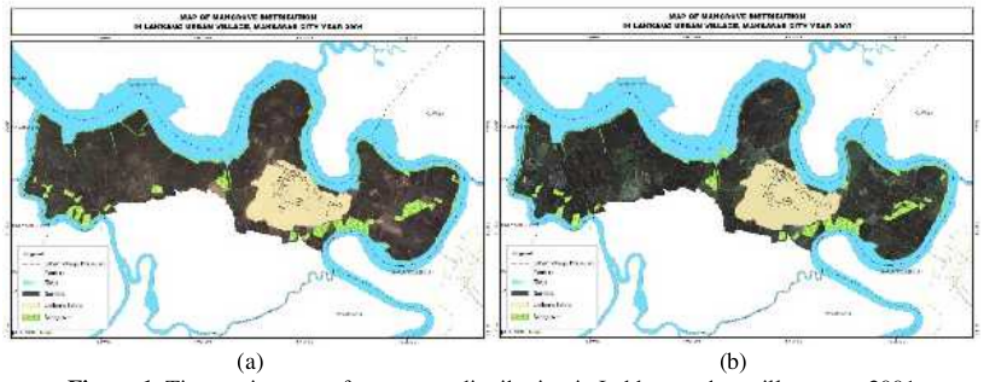


Figure 1. Time series map of mangrove distribution in Lakkang urban village year 2001 and year 2007

In 2013 the government of Makassar began to conserve mangrove forests to minimize the negative impact that will be caused. It can be seen that the population of mangrove plant in the year 2013 until 2018 has increased about 28 ha and 30,18 ha see figure 2.

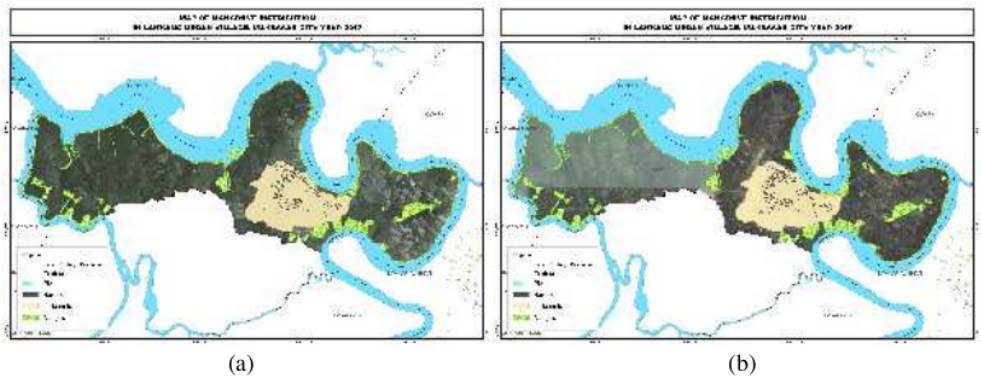


Figure 2. Time series map of mangrove distribution in Lakkang urban village year 2013 and year 2018

The government of Makassar city concern in conserving mangrove ecosystem at Lakkang urban village can be felt positive if the community and the NGO also helped preserve the mangrove ecosystem in the urban village, but still found some people who cut mangrove trees to fulfill the needs of the economy. It happens because of the very lack of understanding about the importance of conserving mangrove forests.

The impact of their economy also increases if they conserve mangrove ecosystems, because the results related to economic studies show that the manufacture of fish ponds every 1 ha in natural mangrove forests will produce shrimps as much as 287 kg/year, but with the loss of every 1 ha of mangrove forest will result in losses of 480 kg of fish and shrimp offshore per year [11]. Reduction of mangrove forests, especially in green belts area will undoubtedly reduce the productivity of capture fisheries. So, we need a strategy in improving and maintaining existing mangrove ecosystems in Lakkang urban village through ecotourism strategy to preserve the environment, especially mangrove plants that can serve as a tool of mitigation. Mitigation is primarily regarding preventing abrasion

around the coast of the island and as a tool for river pollution filters, decreasing environmental temperature and increasing fishery income or economic benefits.

4.2. *Integrated ecotourism strategy based on mitigation*

Lakkang urban village has the potential of natural attractions with a stretch of mangrove forest, historical tourism (bunker relic), traditional house and the strategic location, can be reached by boat only of 20 minutes provided by the community. Currently has been visited by local and foreign tourists. But from the potential of this area there are still many shortcomings that must be fixed are:

1. Lack of public awareness of the importance of mangrove ecosystems;
2. Conditions of japans bunker that is not maintained and has merged with the house of the population;
3. Lack of facilities and infrastructure to support ecotourism;
4. There are no commercial facilities that sell souvenir and culinary that can be purchased by tourist;
5. Lack of attractiveness and uniqueness of attractions;
6. Transportation water is only available at certain hours;
7. Lack of skill and community participation;
8. People are less aware of the potential for ecotourism in the Lakkang urban village.

So, it needs a strategy in maintaining mangrove ecosystems that exist in the Lakkang urban village that is the strategy of ecotourism; researchers take indicators of each component of SWOT to see table 1.

Table 1. Result of SWOT analysis

<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>External</p> </div> <div style="text-align: center;"> <p>Internal</p> </div> </div>	<p>Opportunities</p> <ul style="list-style-type: none"> • Lakkang urban village has the potential to become an ecotourism area; • The existence of business opportunities; • Have criteria as ecological water tourism (mangrove); • Tallo River has the potential to serve as a boating tourism activity; • Having waterway facilities which can be used by tourists to get around enjoying the scenery of mangrove forest. 	<p>Threats</p> <ul style="list-style-type: none"> • The existence of factory buildings and warehouses that are not by the designation location based on Spatial Planning of Makassar City; • Construction of houses without permission; • Access within easy driving distance but only at certain hours; • Lack of attractiveness and uniqueness of the attraction; • Peoples had less direct benefits of mangrove forest.
<p>Strengths</p> <ul style="list-style-type: none"> • in Spatial Planning Makassar City, the Lakkang urban village be included ecotourism area; • There are a few traditional houses that still survive; • The availability of the house as a place of lodging for tourists is a people's house; • There is a japans bunker relic that can be used as a historical tourist attraction; • Lakkang urban village potential for mangrove ecosystem cultivation area. 	<p>Strategy: S-O</p> <ul style="list-style-type: none"> • Nature tourism as tracking activity like travel package in mangrove forest and water tour by boat within 2 km radius from Lakkang Island; • Maintain the traditional houses of Lakkang society; • Provide lodging facility for tourists; • Fixing or arranging japans bunker relict attract tourists. 	<p>Strategy: S-T</p> <ul style="list-style-type: none"> • Arranging the settlement site, facilities, and infrastructure by Indonesian NationalStandard; • Available boat with a schedule that has been arranged so tourists can easily and efficient travel time to the Lakkang island; • More increase the potentiality of ecotourism in Lakkang island; • The strategy for water transport; • Improving boat facilities as a tool for water trip.

Weakness	Strategy: W-O	Strategy: W-T
<ul style="list-style-type: none"> • Still, lack attention of the NGO to the environment of Lakkang island especially mangrove ecosystem; • Lack of public awareness of the importance of the mangrove ecosystem; • Unmaintained vegetation existing on Lakkang island; • Unprecedented of the japans bunker relic; • Lack of supporting facilities and infrastructure; • No trade facilities available that sell souvenirs for tourists. 	<ul style="list-style-type: none"> • Technology strategy: promotion using social media; • Involving the community in the arrangement and control of mangrove ecosystems on the Lakkang island; • Coordination between local communities and stakeholders starting with planning, socialization, implementation, and monitoring of mangrove ecotourism development concept; • Providing knowledge to the community about management and ecotourism management training for effectiveness and productiveness; • Explore the potential of nature and marine tourism with the guidance to the community; • Increase the creativity of the community by making souvenirs and culinary. 	<ul style="list-style-type: none"> • Making japans bunker relic as a power attraction tourist; • Revitalization of mangrove ecosystem; • Improvement of human resources in managing tourist attractions.

Ecotourism development with landscape management, historic site and community culture also mangrove tourism. Management is directed to the sustainability of coastal resources and improving the economy of local communities. The strategy includes:

1. Nature tourism in the form of tracking activity like travel package in mangrove forest and water tour by boat within 2 km radius from Lakkang Island. Provide outbound educational package about mangrove and practice mangrove cultivation along the edge of the island as a tool of natural mitigation disasters and socio-economic disasters;
2. Maintain the traditional houses of Lakkang community with arranging the settlement site, facilities, and infrastructure by Indonesian NationalStandard;
3. Provide lodging facility for tourists and local culinary (river fish, shrimp, ponds, crabs, various hygienic mangrove and Nipah food);
4. Fixing or arranging japans bunker relic as another feature to attract tourists;
5. Technology strategy: promotion using social media;
6. Involving the community in structuring, implementing and supervising mangrove ecosystem in Lakkang island;
7. Improving boat facilities owned by local people as a tool for traveling around and enjoying the trip, schedules have been arranged so that tourists can easily and efficient travel time to and leave the Lakkang island;
8. Increasing human resources by Providing knowledge to the community about management and ecotourism management training for effectiveness and productiveness, alternative souvenir and local culinary.

4.4 Conclusion

Based on the results of the analysis in the year 2001 to 2007, the mangrove area has a land conversion of 3 ha or about 14.24%. In 2013 the government began to revitalize mangrove forests in Lakkang urban village, which increased mangrove population to 28.82 ha and until 2018 about 30.18 ha increased by 1.36 ha. The increasing area of mangrove vegetation is still less than the maximum effort that has been done because the local community does not understand the awareness of the importance of mangrove area as mitigation of natural disaster and socio-economic. Strategies that must be done to

create a sense of ownership of mangrove forests is the development of mangrove ecotourism as an educational tour combined with historical tours, and specific local culture. Management is directed to the sustainability of coastal resources and prosperity of local communities. When the community perceives the economic benefits of tourism activities, the presence of mangroves will be significant. Even without control of the government, the local community will maintain its sustainability.

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