Mangrove ability to support green open space in Mamuju Regency

D A Marsawal
Regional Planning and Development Department, Graduate School, Hasanuddin University, Indonesia

Email: mdianawaliah66@gmail.com

Abstract. Green open space is one important component in developing an area. The proportion of the area of green open space in urban areas based on Law number 26 of 2007 concerning Spatial Planning is 30% of the city area. The green open space is divided into several criteria, namely public green open space and private green open space. Public green open space is open space managed by the government whose use is intended for the community. In addition to the aesthetics of public green open space also functions as an air purifier, guardian of groundwater sustainability, a place for the development of various flora and fauna, also provides economic benefits for the community. Mangrove vegetation has the ability to fulfill the function of the green open space. When developed into an open public heiau space, mangroves can have a positive impact on environmental development. Mangrove vegetation has the ability to minimize the erosion and hydrological standby of the region. Besides, mangroves also have the ability to absorb carbon emissions so as to keep the environment air conducive. Mangroves that are well managed can also create new tourist sites that can improve the economy of the surrounding community.

1. Introduction
West Sulawesi is a province that is located in the west of Sulawesi Island and is a division from South Sulawesi. West Sulawesi has its capital in Mamuju, which has a total area of 4,999.69 km$^2$ or 29.783% of West Sulawesi's total area and consists of eleven districts.

The capital of the Mamuju Regency is Mamuju districts that are on the western edge of the island of Sulawesi and directly adjacent to the Makassar Strait, which belongs to the deep sea category. This condition makes Mamuju very vulnerable to high waves from the Makassar Strait. Mangrove is one of the plants that are suitable for cultivation in coastal areas such as in Mamuju, in addition to its benefits as a breakwater, mangroves can also be economic support for the surrounding communities. The important role of mangroves can be seen from their ability to reduce coastal storms and wave energy retain sediments, assimilate nutrients to be converted into plant tissue, and provide protection for fish and other marine biotas. The role of other mangroves is to reduce marine pollution from the mainland [1]

There are several factors that can affect the climate of an area, such as population, industrial and transportation activities, land use, size, and structure of cities. These factors also continue to develop along with the times [2]. Green open space (GOS) has a quite influential role in creating stable air content in an area. Research result [2] stated that the area of green space in Palu the period of 1997 to 2010 continued to decrease, and one of the causes was the rate of urban growth and population
development. This affects the maximum temperature increase in the city of Palu from 34.5°C to 36°C. The research shows that the area of green space in an area is directly proportional to the temperature in that region.

In several studies explain that mangrove forest is one of the vegetation that has the ability to absorb carbon dioxide emissions and be able to maintain the surrounding air conditions [2–5] so that mangrove cultivation can be an alternative in increasing the area of GOS. The purpose of this paper is to explain the extent of the ability of mangroves to support the function of green open space in Mamuju. This research is also expected to increase local government and community awareness of the importance of mangroves and maintain their sustainability.

2. Methods
The GOS of Mamuju is increasingly decreasing, and it is based on data from the Mamuju Regency Environmental Servis in 2014. This condition must be a concern for all parties, both the government and the local community.

2.1. Study area
This research was conducted in Mamuju, which is the capital of West Sulawesi Province, with an area of 4,999.69 km², which consists of 11 sub-districts, most of which are coastal areas.

![Figure 1. Mamuju administrative map [6]](image_url)

2.2. Research methods
This research uses qualitative methods with a literature review of existing research. Data collection techniques carried out by interviews, literature, and based on reports that have been processed by the local government in this case, the regional work unit related to mangrove management and GOS.
3. Result

3.1. Green Open Space
A conducive area will support sustainable development in an area [3]. The benefits of green open space (RTH) can be felt directly because green space creates beauty and comfort (shady, fresh, cool) and from green space can also provide economic benefits (wood, leaves, flowers, fruit), while indirect benefits from green space (requires a long time in making it happen) that is very effective as an air purifier maintaining groundwater supplies. Environmental preservation, such as existing flora and fauna (biodiversity conservation or biodiversity) [7].

The existence of green open space in Mamuju Regency has changed its function, based on the results of interviews from The Mamuju District Office before officially becoming the capital of West Sulawesi, Mamuju has 6 (six) GOS points, but over time the GOS is gone because most have already converted to settlements population. Environmental problems will slowly arise if the regional green space does not meet the requirements and criteria that should be [3].

Green open spaces in urban areas should be positioned at least 30% of the city area [8]. Mamuju city area based on Landsat imagery using GIS is 1,592.4 Ha [9] so that the minimum available area of Mamuju RTH is 477.72 Ha. The area of green open space has not yet been fulfilled in Mamuju, so the local government is making plans to develop green open space to achieve this proportion.

![Figure 2. GOS Distribution of urban areas Mamuju [9]](image)

3.2. Mangrove Forest In Mamuju
Mangrove is one of the green space vegetation, which has the largest area of 3 types of green space vegetation in Surabaya with uneven distribution [3]. This condition is in line with the conditions in
Mamuju, where the Mamuju region is dominated by coastal areas that stretch on the east side into good mangrove breeding grounds.

Mangrove density in West Sulawesi is divided into rare, moderate, and very dense categories. The percentage of mangrove density in West Sulawesi is 40% for the very dense category, 30% for the medium category, and 30% for the rare category. For the Mamuju region with a very dense mangrove density found in the Mamuju District area in the coastal area as well as in Karampuang Island, Kalukku and Papalang [10]. Papalang District is one of the Mamuju areas in the coastal area with quite a large mangrove vegetation, in addition to being included in the very dense mangrove density category, several areas in Papalang are also included in the medium category for mangrove density [10].

Mangroves are green vegetation that has the ability to absorb carbon dioxide emissions [11,12]. In addition, the tendency of mangroves to live in groups is the main attraction of this vegetation. Currently, mangroves have been developed into tourist sites that are quite the target of tourists. Mangrove tourism if managed well by the government, can open the economic development of the community and become the main attraction of the region.

3.3. Mangrove ability to support the functions of green open space
Mangrove forests meet the criteria to be set as green open space. Mangroves are green vegetation that has high aesthetic value if managed and preserved properly. Mangrove forests store carbon five times more than highland tropical forests [13]. Indonesian mangroves also store 3.14 billion metric tons of carbon (PeC) with 78% carbon in the soil, 20% carbon in living trees, roots or biomass, and 2% in trees dead or fallen [14]. Mangrove contains a number of organic materials that do not rot. Therefore, mangroves function more as carbon sinks than carbon sources [15].

Mangrove forests are the densest carbon-rich forests in the tropics [16]. In addition to ecological benefits, mangroves also have economic benefits [17], but the economical use of mangroves needs to be regulated so as not to damage the ecosystem. Mangroves developed into ecotourism will create a dual function, namely, a direct function on the environment by becoming a place for breeding various marine biodiversity such as fish and shellfish, crabs, and other marine biotas, besides mangroves can also be an educational tourist attraction [18].

GOS has 3 (three) basic functions, which are social functions for the community because it is a public facility that can improve community interaction and communication, physical functions, such as the lungs of the city, protecting the sustainability of the water system, silencing the sound, controlling the development of built land, and protect city residents from air pollution, as well as aesthetic functions, namely as a binder between elements in the city, giving features in shaping the face of the city [19].

Mangroves have fulfilled most of the green space functions, but the determination of mangroves as green open space requires the role of the government because mangroves are vegetation that needs to be taken into account its sustainability considering the many benefits of mangroves for the environment and the existence of mangroves that are decreasing day by day due to land-use changes that are not taken into account the good impact on the environment [20].

4. Conclusion
Mangroves are one of the vegetation with a myriad of benefits both for the environment and for the community. The ability of mangroves to support the function of green open space can no longer be doubted. Mangroves are able to absorb carbon emissions and maintain air stability and can be a medium of social interaction, besides mangroves can be ecotourism as well as an educational tour for the community. Various types of marine life make the mangrove area a breeding ground. The extent of mangrove vegetation in Mamuju is an opportunity for this region to meet the proportion of existing green open space by establishing the mangrove area as green open space. The establishment of mangroves as green open spaces can also have a positive impact on the economic development of the community.
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