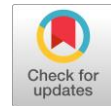# The determination of green open space (GOS) in Palu based on total population and area

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ABSTRACT

Green Open Space (GOS) is the most important factor of a city formation structure. Green open space is very much needed around the downtown area due to its function that supports the ecology of a city. The quality of environment are becoming healthier hence the function of green open space as a recreation area in the downtown. Green Open Space can also function as a spot where people are able to socially interact with each other, function in culture aspect and even function as an area to support the economy of the community around the existence of the green open space. Urban area of Palu city has high temperature because it passed by the equator, sometimes it reaches 36 ℃, even if it is raining during the night but still it is very hot in the daylight. Determination of how green open space starts is from population density and area, it can be seen through several sub-districts because the population of each sub-district is different in terms of number and area. Therefore, it should be regulated from several existing districts. Palu City consists of 8 districts with varying population densities. Method used was quantitative analysis through calculating the need for green open space based on thepopulation in each district. The data were analyzed through the formula and the coefficient per capita. Then it is described in maps of sub-districts in the city of Palu. The results of this research will provide how many public open space is spread in the city of Palu as the capital of Central Sulawesi Province. This can be applied to the map of Palu City. The results of the research will show how many public open spaces are in each sub-district.

1. Introduction

The importance of green open space in urban areas is where land cover dominated by vegetation, urban green open space has another function besides being a place to relax and a place for recreation. Other functions are ecological and aesthetic functions of a city [1].

The existence of green open space is closely related to the development of a city in accordance with human demands, because the development of a city requires the formation of public spaces. The benefits of green open space with its ecological functions are needed by humans and the benefits of green open space itself. Green open space is an element of an urban area that has a character and function of interaction for people living in urban areas [2]. The economic function is also included in the green open space function, where the commercial value for community businesses support green open space in urban areas [3].

Based on Law number 26 of 2007 concerning spatial planning, article 29 states that the determination of green open space in the city center is 30% of the total area, the proportions of which are 20% for public green open spaces and 10% for private green open spaces which also generally

applies to areas. housing, malls, shops and offices, where it is absolutely necessary according to the law. This proportional GOS is intended to achieve environmental balance and so that GOS based on quantity and quality can be maintained [4]. The conversion of land functions is created by the current development of the city, therefore, green open space has changed its function to become built-up land. The area of Palu city currently shows that environmental conditions are not yet optimal and the percentage of green open space has not been achieved in terms of the environment, namely in the form of pollution and problems related to environmental quality, such as in terms of the climate and pollution of Palu city. The purpose of this study was to find out how many green space needed in the downtown of Palu city, based on the population and area per district and according to the Minister of Public Works regulation number 05 / PRT / M / 2008 [5], where the calculation of GOS is based on the population coefficient per capita, namely show in Table.1 :

Table 1.   Above is used to calculate the area of green open space requirements

Total population	Minimum per capita area
250 inhabitants	0,2 m2
2.500 inhabitants	0,2 m2
30.000 inhabitants	0,3 m2
120.000 inhabitants	0,2 m2
480.000 inhabitants	4.0 m2
	Structure of urban forest

The structure of green open space in urban areas is as follows [6]:

- Green lanes of shade trees on roads, green lines under high voltage electricity, green lines alongside railroad roads, green lines on riverbanks. These lines can be developed inside the city or outside the city as green open space to improve the quality of the surrounding environment.

- City Park, a garden that can be interpreted as a plant in the garden and arranged in such a way as to get a beautiful composition.

- Gardens and yards, where the types of plants planted in gardens and yards are usually productive plants that produce fruit, sometimes not expected fruit.

- Kebunraya, botanical forests and zoos, this can be included in one form of green open space for plants originating from the local area, other areas or abroad.

- Protected forests, namely areas of steep slopes, must be converted into forest areas because they are prone to landslides. Likewise, a beach that is prone to sea water should be used as a protected forest.

- Heroes' graves and graveyards, which usually have lots of trees.

Problems in urban areas cannot be separated from the availability and optimization of inadequate green open space arrangement, such as incident in 2018 where the government only focused on providing physical advice and infrastructure, instead of putting attention to the green open space both in quality and quantity [7]. In accordance with Regional Regulation number 16 of 2011 concerning the Palu city spatial plan, which states that the City of Palu is creating a number of green areas. This regulation has not been completed when Palu City was shaken by the eaGOSquake in 2018, this shifted concentration of the government. The neighborhood and hamlet of Palu City is currently working on building green open spaces in the form of parks, urban forests, protected forests, etc [8].

GOS classification According to the Judge, 2007 Green open space based on its layout and function can be classified as a division. Based on its layout, green open spaces can be in the form of open spaces in coastal areas (coastal open spaces), river flood plans, open spaces for security of barrier-free roads (green way), and open spaces for security of accident hazard areas at the end of the airport runway, the classification of GOS can be divided into [9]: 1) City park green area. 2) City forest green

area. 3)City recreation green area. 3) Sports activities green area. 4) Cemetery green area. 5) Agricultural green area. 6) Green belt green area. 7)Green yard area.

1.1. Function and Benefits of GOS

The functions and benefits of green open space are generally intended to suppress the negative effects that will be caused by the urban environment. The negative effect in question is an increase in urban micro temperature which can be caused by solar radiation, air pollution, and urban air humidity. Vegetation has an important role in human life. This is resolved by the role of greening as an ecological function of vegetation. The functions and roles of vegetation in green open space are [10].

- Plants as a green element can function city lungs where the growth process can produce O2 which is needed by humans.

- Vegetation can function as a regulator of the micro environment so that it can provide coolness and comfort to the surrounding environment.

- Greening can create space for living things in nature that allows natural interactions to occur.

- Can be a formation of natural life for the surrounding animals.

- Water control and erosion prevention.

- Serves as protection from the sun, dust and vehicle pollution as well as odor pollution and can divert strong winds.

- Can absorb certain pollutant.

- It has a canopy, canopy and ecological leaf cover.

- Can help clean water for certain plants meaning that it can clean and purify water; 10) Vegetation can absorb noise or noise pollution.

- Plant elements if arranged properly with various types and arranged in regular patterns will create a good aesthetic value.

- The color and character of vegetation will have an impact on health therapy, especially eye health.

- Providing scientific value if this vegetation is planted in a variety of ways will be useful for practicum for education such as making urban forests.

- Provide recreational value for green open space as a place to relax with family.

- Providing social, cultural and economic values for the surrounding community.

- Become an indicator and guide for the environment.

Besides the functions mentioned above, GOS also has the function of edaphis is as a place to live for animals in the presence of trees. Climatological function which can reduce the temperature of the environmental micro air. The hydro-orological function is to protect the sustainability of soil and water [11].

- The protective function is to protect against wind, noise and absorb solar thermal radiation.

- Hygienic function which can absorb pulusi both in air and in water.

- The educational function is a source of knowledge about vegetation.

- The aesthetic function is by arranging various kinds of natural vegetation which will give biGOS to the aesthetic function of the area.

- Socio-economic functions for local communities.

- Provision of Green Open Space in urban areas.

In Law Number 26 of 2007 [12] concerning Spatial Planning, the amount of GOS is at least 30% of the total area of the city. Meanwhile, according to the Directorate General of spatial

planning in 2006, GOS between cities is at least 0.25 Ha and the proportion is 10% of the local city area. Based on the Regulation of the Minister of Public Works Number 05 / PRT / M / 2008 [12], the provision of GOS in urban areas can be concluded as.

- The provision of green open space is based on the area, which consists of 20% public green open space and 10% private green open space, but if the existence of green open space both public and private has a total area that exceeds the capacity it should be, this proportion needs to be maintained.

- Provision of GOS based on population.

Based on this, the number of people served by the standard area of green open space per capita is in accordance with existing regulations, namely based on the population Table. 2 .

Type GOS garden RT 250 inhabitants Type GOS park RW 2500 inhabitants Urban village type of 30,000 inhabitants District park type 120,000 inhabitants. City Park type 480 soul, this includes cemeteries and urban forests.

2. Method

This research uses quantitative methods that describe the phenomenon and calculate the results. The results obtained were applied to a map of the city of Palu, therefore the amount of green open space that will be obtained from these calculations appears. The research location is in the city of Palu as the capital of Central Sulawesi Province. The position of the city of Palu is passed by the equator so that the air temperature in the city has solar heat radiation of 34 °C, it is necessary to set green open space that can provide comfort, green open space functions as a climatological absorber. According to the regulation of the minister of public works.Determining the area of green open space based on the population, the following formula can be made:

GOS Pi   = Pi x k….m2/person

Where: Pi   =The number of inhabitants

K   = Based on the minimum area rule per person per capita

With this formula, quantitatively, the total area of green open space is obtained. This calculation is used to calculate per district in the city of Palu to find a shortage of green open space based on population are:The area of green open space based on population calculations = the current area green open space - the area of green open space, there will be a shortage of green open space if there is an increase in population. By using this formula analysis, it is possible that there are expansion areas that are large but have less population.

3. Results and Discussion

The city of Palu, which consists of 8 sub-districts, has developed from 4 sub-districts to 8 sub-districts and several years after the division, an eaGOSquake devastated the province of Central Sulawesi with its capital city Palu. Thus, green open space is no longer a priority, what is of concern is starting the construction of the city facilities and infrastructure needed, even though green open space is one of the development priorities according to the Palu city neighborhood and hamlet 2010-2030. Thus the researchers tried to formulate through research the need for green open space in the city of Palu through the expansion of 8 sub-districts. Namely according to BPS data [13] as well as the area of public green open space in each district show in Table. 2:

Table 2. Total population and the area of green open space in 2019 [13]

Sub-district	Population	Sub-distric are Km2
West Palu	63.251	8,82
Tatanga	40.612	14,95
Ulujadi	28.190	40,25
South Palu	71.657	27,36

Sub-district	Population	Sub-distric are Km2
East Palu	72.552	7,71
Mantikulore	64.785	206,50
NoGOS Palu	23.550	29,94
Tawaeli	21.022	59,75

Table of green open space per district is show in Table. 3:

Table 3.   Table of green open space per district

Sub-district	The area of GOS with details of the allocation of Ha		
West Palu	1.07	Field of masjid Agung 1Ha	
		Garden in front of SMA4 0,7	
Tatanga	2.52	Roundabout at palupi 0,1	
		Field in st. agatis 0,8	
		Field in nunu 0,32	
		Field in Galara 1,3	
Ulujadi	0.25	Garden at BTN Silae 0,25	
South Palu	3.2 Ha	Field of .Faqih Rasyid 1	
		Football field 0,6	
		Mini stadium in petobo 1,2	
		T-junction in ramba 401m2	
		Doyata park 1,14	
East Palu	3.19	Roundabout in smp 2 0,5	
		GOR Park 2	
Mantikulore	67.92	Roundabout in STQ 0,22	
		City Forest 64,3	
		Talise field 0,92	
		Vatulemofield 2,48	
NoGOS Palu	2.,75	Football field	1
		0,78	
		Football field	2
		1,20	
		Football field	3
		0,77	
Tawaeli	2.27	Football field	1
		0,67	
		Football field 2	0,76
		Football field 3	0,84

The calculation of the shortage of area that must be added to the population growth uses the following formula:

Lack of GOS = current area - The area of population calculation

- Mantikulore sub-district, show in Fig.1

GOS pi   = pi x k…m2/capita

64.785 inhabitants x 0,3 m2   = 19435 m2 = 1,9435 Ha

Lack of green open space land   = 67,92 Ha- 1,9435 Ha = 66,02 Ha

This is due to the area with a minimal population, in this sub-district there is also an area of urban forest, while according to ministerial regulations, the city forest can be constructed with a population of 480,000 people, while the city of Palu does not reach a population of 480,000, only 368,086 people in 2019 with an area 395.06Km2.
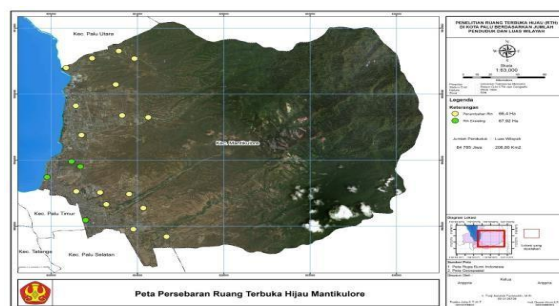
Fig. 1. The Spread of GOS in Mantikulore sub-district

- Tatanga Sub-district, show in Fig. 2

GOSpi   = pi x k…m2/capita

                         = 40.612 x 0,3 m2/capita

                         = 12.186,6 M2 = 1,22 Ha

Lack of area   = L current – GOSpi

                         = 2,52Ha-1,22Ha

                         = 1,3 Ha
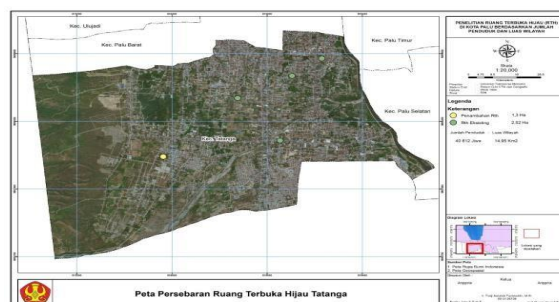
Fig. 2. The Spread of GOS in Tatanga sub- district

- South Palu sub-district, show in Fig. 3

GOSpi   = pi x k….m2/capita

                              = 71.657 x 0,3 m2/capita

                              = 21.497,1 m2 =2,15 Ha

Lack of area   = L current-LGOSpi

= 4,54Ha-2,15Ha

= 2,19 Ha

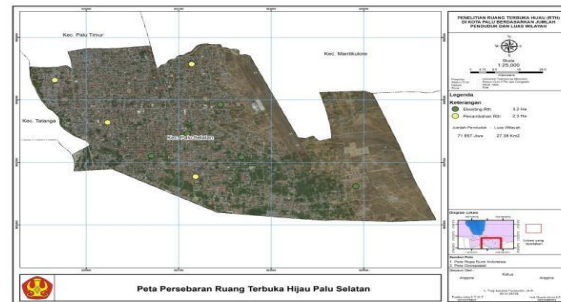**Fig. 3.** The Spread of GOS in south Palu sub- district

- West Palu sub-district, show in Fig. 4

GOSpi   = pi x k…m2/capita

       = 63.251 x 0,3 m2/capita

       =18.975,3 m2= 1,9 Ha

Lack of area   = L current-LGOSpi
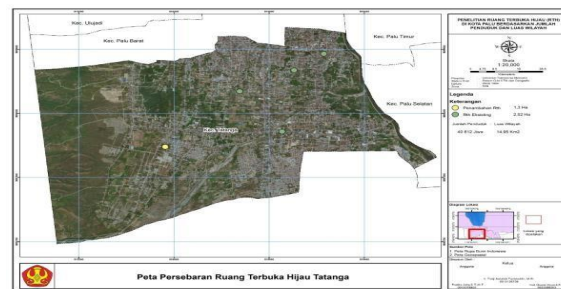
       = 1,07 ha – 1,9Ha

       = - 0,83 Ha

Fig. 4. The Spread of GOS in west Palu sub- district

- Ulujadi sub-district, show in Fig. 5

GOSpi   = pi x k…m2/capita

       = 28.190 x 0,3 m2/capita

       = 8.457 m2 = 0,8 Ha

Lack of area   = 3.2 Ha-0,8 Ha

       = 2,4 Ha

Fig. 5. The Spread of GOS in Ulujadi sub- district

- East Palu Sub-district, show in Fig. 6

GOSpi   = pi x k…m2/capita

                     = 73.532 x 0,3 m2/capita

                     = 22.605 m2= 2,2,Ha

Lack of land   = 3.19 Ha – 2.2ha

                     = 0.99 Ha
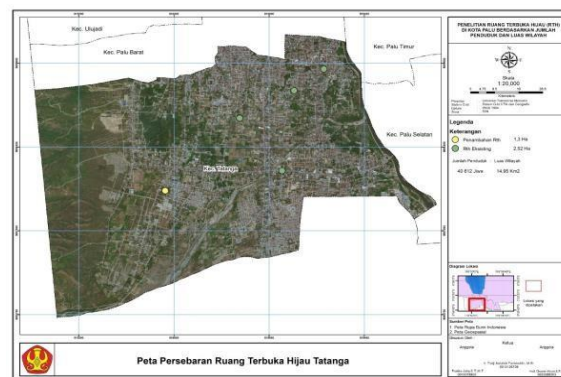
Fig. 6. The Spread of GOS in east Palu sub- district

- Tavaeli Sub-district, show in Fig. 7

GOSpi   = pi x k…m2/capita

                     = 21.022 x 0,3 m2/capita

                     = 6.306,6m2 = 0,63 ha

excess area   = 2.75 ha-0,63ha

                     = -2,12ha
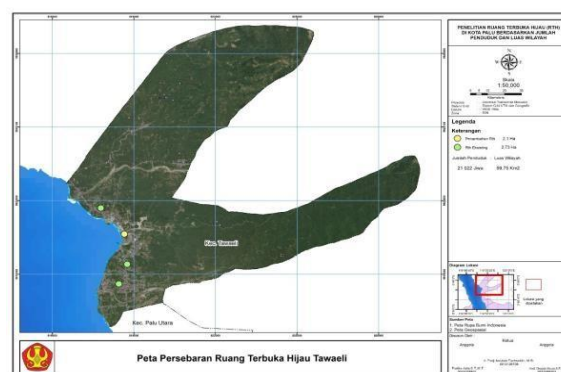
Fig. 7. The Spread of GOS in Tavaeli sub- district

- NoGOS Palu sub-district, show in Fig. 8 and Fig.9

GOSpi   = pi x k…m2/capita

                     = 23.550x 0,3 m3/capita

                     = 7.065 m2 = 0.7ha

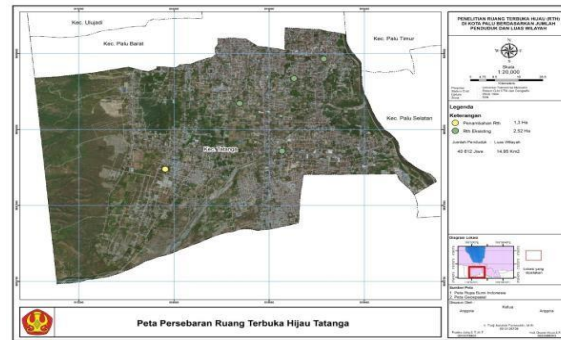Lack of area   = 2,75ha -0,7ha

                     = 2Ha

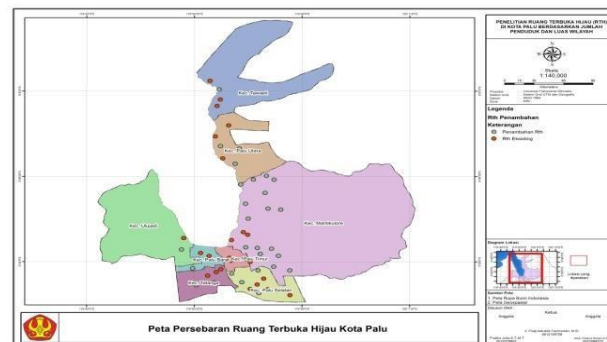**Fig. 8.** The Spread of GOS in noGOS Palu sub—district

Fig. 9. The calculation results of the land size distribution of green open spaces in the city of Palu

4. Conclusion

Based on calculation above therefore it can be concluded that: There are areas in which the calculation of minus land means that there is no need to reduce it, the area will remain the same due to the possibility of developing other types of public green open spaces (GOS). Particularly for the expansion areas whose size is not proportional to the total population such as: 1) In areas that have expanded, the population and land area are not suitable, for example in the Mantikulore sub-district, the area of land compared to other districts is the largest with a small population so that the calculation of green open space results in minus but this does not need to be reduced because the government will continue the construction of urban Forest; 2) In the regulation of the Minister of Public Works, city forests can be worked on if an area has a population of 480,000 people with a value of 4 m2 per capita.

Declarations

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