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RESEARCH ARTICLE

WATERSHED IDENTIFICATION AND ITS EFFECT TOWARD FLOOD (CASE STUDY: MAKASSAR CITY).

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Abstract

The city of Makassar is located in Maros, Tabaringan, Tallo, Jeneberang and Gowa-Takalar watersheds and Makassar non-watershed areas.This area is located along the coast of Makassar City whose stream flow is directly mainly to the sea or through small rivers (creek). For the calculation of flood discharge, the study of watershed becomes crucial to know the position of study area to the influence of upstream river basin. Watershed area is very influential to flood discharge.In general, the larger the watershed the greater the amount of surface runoff is so that the greater the flow of surface or flood discharge. This study aims to identify the watershed and its effect towards floods in Makassar. By using an integrated spatial analysis method in Geographic Information Systems (SIG) version 10.5 application, the watershed of Makassar can be identified. The results show that watershed in Jeneberang region is the largest watershed area that empties into Makassar City. The watershed reaches 76,085.06 hectares while the Gowa-Takalar watershed is the smallest of 1.88 hectares. There are 2 watershed areas that have no effect on the risk of flood in Makassar City namely Maros watershed and Gowa-Takalar watershed. The research results can be utilized for water resource management needs such as primary and secondary flow planning, both by practitioners and the government of Makassar City.

Introduction:-

Watershed is a land area that is adjuncted with the river and its tributaries bounded by the ridges of mountains. This serves to accommodate, store, and drain water that derive from rainfall to the lake or to the sea naturally (Candra, 2003; Triatmodjo, 2013; Prastiwi, 2014; Yin, Yu, et all, 2016). From the place of origin to the end of the sea or from the geographical location of the river can be categorized into three main parts: the upstream (mountain), transition and downstream areas (beach), these three areas also show the nature and characteristics of different river systems (Kodoatie, 2013).

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Land utilization is one component of watershed, so when the watershed component changes mainly land use, it indirectly influences the flow of flow (Febryanto, 2016; Brogna et al., 2017; Liu & Shi, 2017). Wide watersheds are very influential to river flow, in general the larger the watershed the greater the amount of surface runoff so that the greater the flow of surface or river flow, the measurement of river length and length of the watershed is important in the analysis of runoff flow and river flow discharge (Triatmodjo, 2013; Sajikumar & Remya, 2014; Szczypta et al., 2015). The amount of flow within the river that affects the flood discharge, flood pattern is determined mainly by the amount of rain, the rain intensity, the area of rain, the time of rain, the area of the river and the characteristics of the flow areas such as topography, plants and geology (Subarkah, 1980; Takeda, 1983; Potdar, 2016).

The development of Geographic Information Systems supported by cutting-edge technology allows the mapping of natural resources well to facilitate work processes (Candra, 2003; Haque & Basak, 2017; Kourgialas & Karatzas, 2016; H. Liu, Lu, et all, 2012; Zhang & Pan, 2014; Sarhadi, Soltani, et all, 2012). With the ease and advantages provided in remote sensing and Geographic Information System, it will help identifying and mapping the watershed causing floods in Makassar city.

This study aims to identify the watershed that affect flooding in the city of Makassar. Identification is done by using application based on Geographic Information System (GIS). The results will be used to calculate flood discharge in Makassar city.

Data and Method:-

Research Object

The study is located in Makassar City, the boundary of the research area is determined based on the boundaries of the districts that have the coastline. The delineation of the research object is shown in Figure 1.

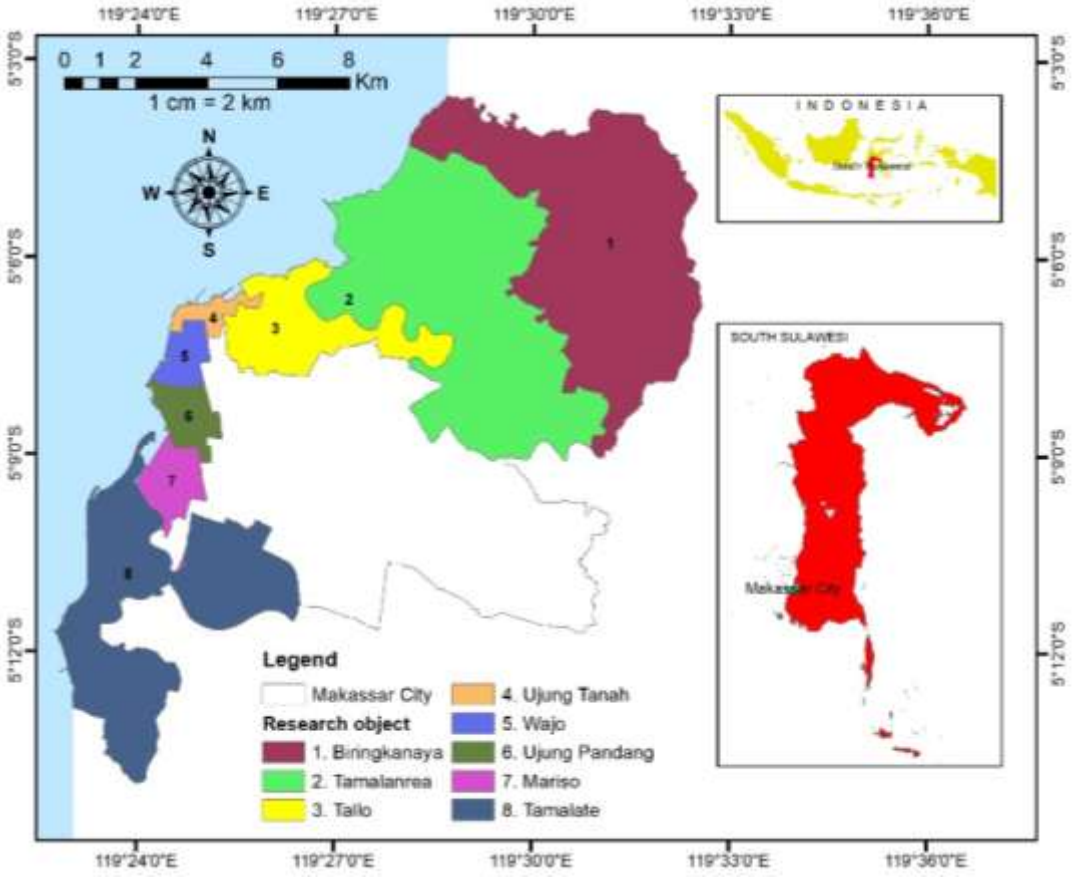

Figure 1:-Research object

Source of Research Data:-
Data used is DEM (digital elevation model) residing in column / line (114/64), Entity ID: ASTGDEMV2_0S06E119, date of acquisition October 17th 2011, accessed on site: https://earthexplorer.usgs.gov/.

Analysis Technique:-
By utilizing the application of Geographic Information System (SIG) version 10.5 from ESRI Indonesia, the watershed is identified by spatial analysis method which is done by several stages, including; map algebra, hydrology, raster calculator, flow direction, flow accumulation, stream link and watershed.

Results and Discussion:-

The results showed that Makassar City consists of 5 watershed areas ie Maros watershed, Tabaringan watershed, Tallo watershed, Jeneberang watershed and Gowa-Takalar watershed. Some areas of Makassar City are non-watershed as informed in Figure 2.

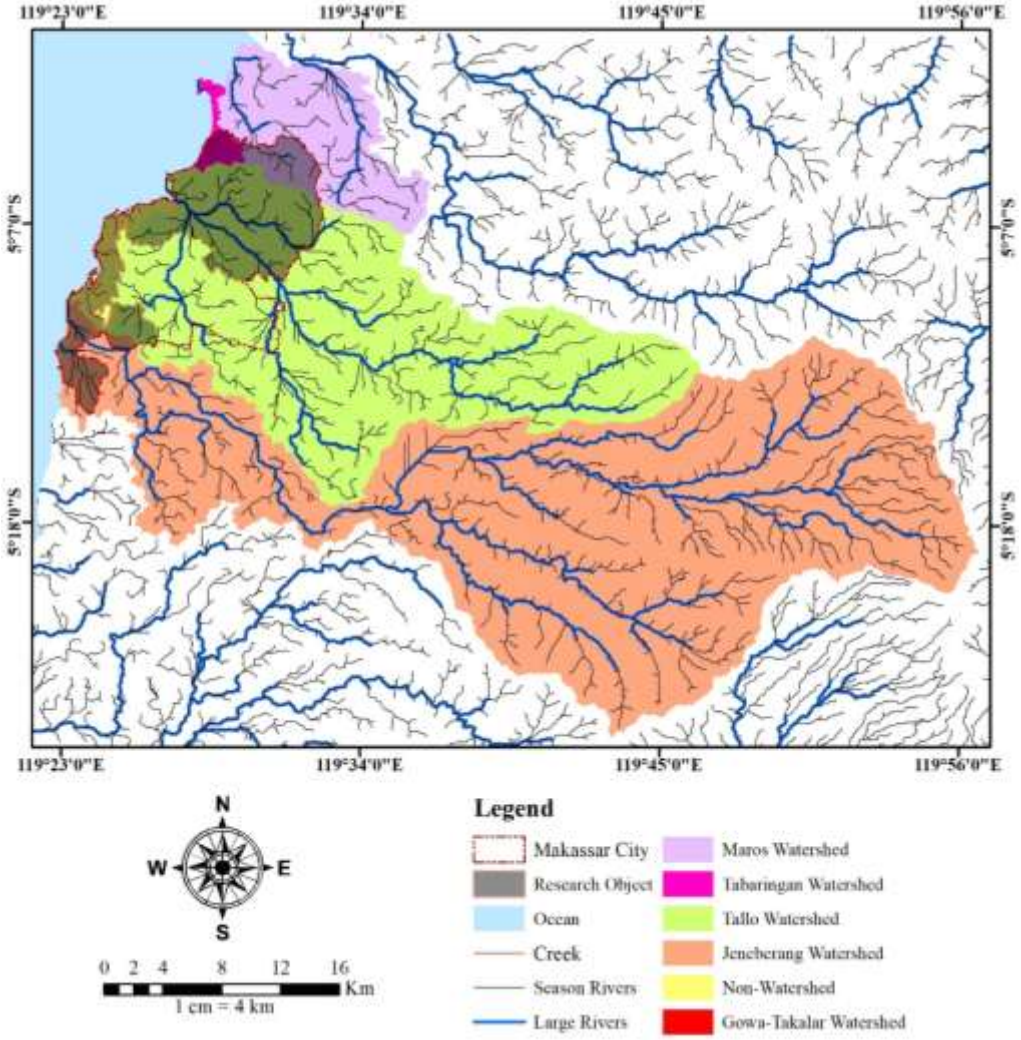

Figure 2:-Watershed that affect of the Makassar City

As it is known that the area of a watershed is a component of several equations to calculate the flood discharge (Q). The rational method approach uses the equation Q = 0.278CIA, where "A" is the area of the watershed in units of square kilometers (Kodoatie, 2013; Samaawa, 2016). The watershed in association with Makassar City as shown in Table 1.

Table 1:-Watershed that associated with Makassar City

Description	Area (Ha)	Percent (%)
Maros watershed	10,223.34	7.698
Tabaringan watershed	850.76	0.641
Tallo watershed	43,853.74	33.023
Jeneberang watershed	76,085.06	57.294
Makassar non-watershed	1,783.77	1.343
Gowa-Takalar watershed	1.88	0.001
Total	132,798.55	100.00

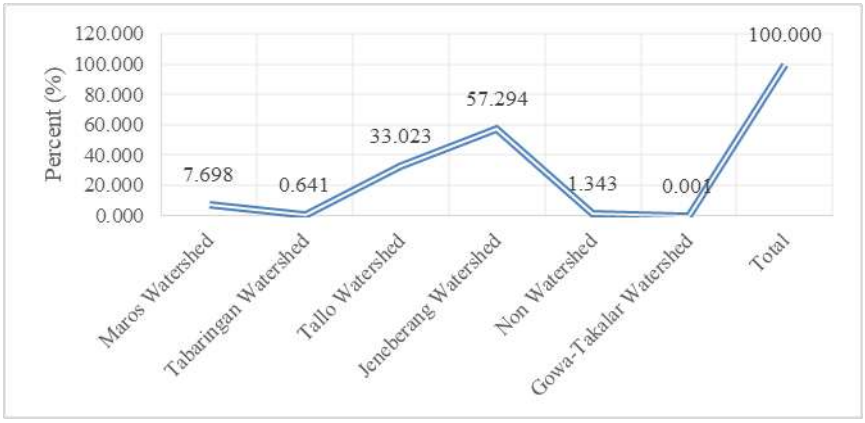

Figure 3:-Graph of watershed that associated with Makassar City

Based on Figure 2, can be determined the watershed that influences the flood at the research object. Data of each watershed as indicated in Table 2.

Tabel 2:-Watershed that effect flood at research object

Description	Effect towards flood	Wide (Ha)	Percent (%)
Maros watershed	No effect	1,290.07	10.89
Tabaringan watershed	Have effect	550.95	4.65
Tallo watershed	Have effect	6,813.06	57.50
Jeneberang watershed	Have effect	1,409.45	11.89
Makassar non-watershed	Have effect	1,783.77	15.05
Gowa-Takalar watershed	No effect	1.88	0.02
Total		11,849.18	100.00

Figure 4:-Graph of watershed that effect flood at research object

Shape of watershed:-
Watershed has various forms based on topography and geology. Broadly speaking the form of the watershed (Kinori&Mevorach) is grouped into 3 (three) namely: elongated shape, widened shape and fan shape (Kodoatie, 2010).

Maros watershed and Tabaringan non-watershed:-
The Maros watershed can not be defined because it is not described as a whole, while the Tabaringan watershed is categorized as fan-shaped and its drainage is creek. The watershed shape is shown in Figure 5.

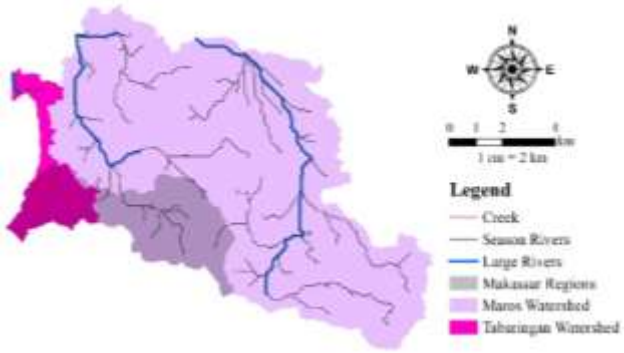

Figure 5:-Shape of Maros watershed and Tabaringan watershed

Tallo watershed:-
The Tallo watershed is categorized as an elongated watershed because the ratio between the length and width of the basin is greater than 1:1,7 (Richards, 1950) in (Kodoatie, 2013).

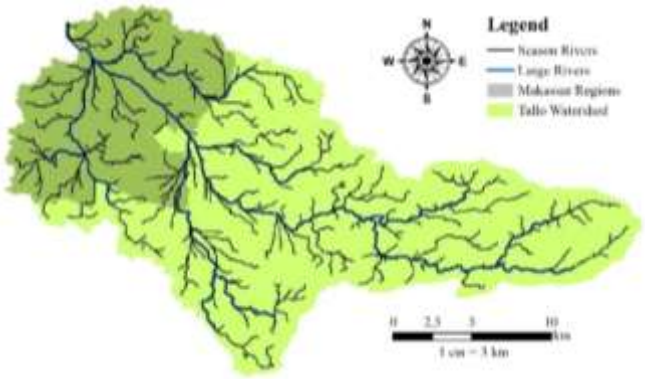

Figure 6:-Shape of Tallo watershed

Jeneberang watershed:-
Based on Figure 7, can be stated that Jeneberang watershed belongs to the category of elongated shape.

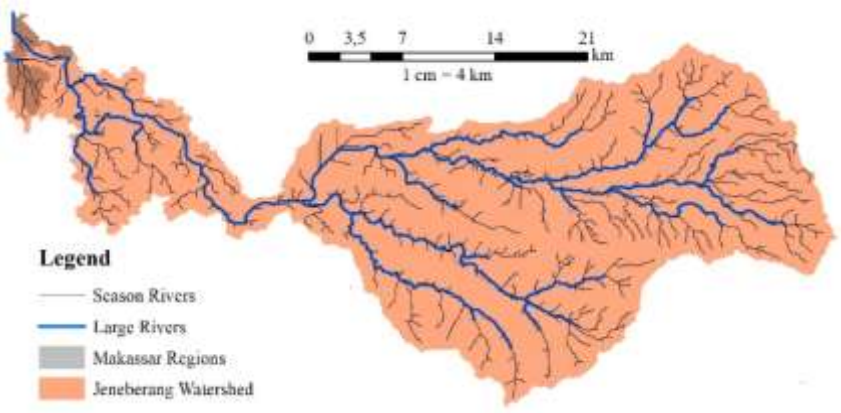

Figure 7:-Shape of Jeneberang watershed

Makassar non-watershed and Gowa-Takalar watershed:-

The Makassar non-watershed can not be defined as a watershed due to its drainage in the coastal region of Makassar City, as well as the Gowa-Takalar watershed is not undefined because it is not described as a whole. The watershed shape is shown in Figure 8.

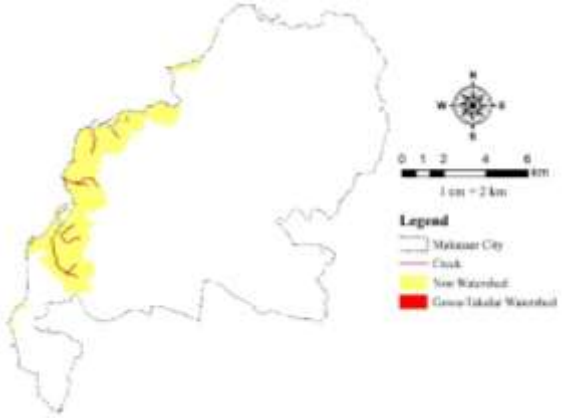

Figure 8:-Shape of Makassar non-watershed and Gowa-Takalar watershed

Conclusion:-

The results show that Makassar is located in Maros watershed, Tabaringan watershed, Tallo watershed, Jeneberang watershed, Gowa-Takalar watershed and Makassar Non-watershed. Jeneberang watershed is the largest watershed area that empties into Makassar City, the watershed reaches 76,085.06 hectares while the Gowa-Takalar watershed is the smallest of 1.88 hectares. There are 2 (two) watershed areas that have no effect on flood in Makassar City namely Maros watershed and Gowa-Takalar watershed, the runoff of both watersheds flows out of Makassar area when it rains. In the research object, the area of each watershed ie Maros watershed covering 1,290.07 hectares, Tabaringan watershed covering 550.95 hectares, Tallo watershed covering 6,813.06 hectares, Jeneberang watershed 1,409.45 hectares, non-watershed of Makassar covering 1,783.77 hectares and Gowa-Takalar 1.88 hectares. The shape of each watershed ie Tallo and Jeneberang watershed shaped elongated, Tabaringan watershed is categorized as fan-shaped, and others watershed undefined.

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