Land suitability analysis using geographic information system (GIS): a case study in Soppeng district

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Abstract. The agricultural sector is a sector of the economy that is still the flagship in various regions in Indonesia, especially Soppeng regency. The area of Soppeng hills is approximately 800 km2 and is at an average altitude of 200 m above sea level, and has no coastal area. The utilization of Geographic Information Systems (GIS) promises resource management and modeling, especially quantitative models, to be more accessible and simpler. GIS is an efficient and effective way to know the characteristics of a region's land and its development potential. Land suitability is the suitability of land for a particular purpose of use through the determination of land value (class) and land use patterns connected to the territory's potential. It can be attempted more targeted land use along with its sustainability maintenance efforts. The spatial analysis involves modeling, testing, and interpreting model results to extract or form new information from a collection of geographic elements. This research will be carried out for 12 Months (1 year) through 4 stages. The research aims to identify land use's suitability in the analysis of agricultural land suitability using geographical information systems in Soppeng regency area.

1. Introduction
Geographic Information System, abbreviated as GIS, is an information system designed to work with spatially differentiated or geographically coordinated data. In other words, a GIS is a database system with the special ability to handle spatially different data along with a set of working operations. Also, GIS can combine data, organize data, and perform data analysis that will eventually produce output referenced in decision-making on geography issues.

Soppeng regency is one of the districts in South Sulawesi that has a large agricultural area. With geographic information systems, people, companies, and government agencies can manage field data more quickly and in detail. One of these services is the Department of Agriculture, Fisheries, and Forestry of Soppeng Regency. The office has the main task of carrying out decentralized authority in the field of agriculture in Soppeng Regency, agricultural data on both agricultural land and harvest commodities so much in the field, so that the office desperately needs a Geographic Information System for mapping agricultural land and commodity crops in Soppeng Regency. In addition to mapping agricultural land and commodity crops, the office also records farmers' groups and farm landowners for the distribution of government assistance[1].

Determination of agricultural land should pay attention to the suitability of the land by its growing requirements. To determine the choice of location is generally used a method of land suitability analysis. According to Z. Maddahi [2], land evaluation or land suitability is an approach or way to assess a land resource's potential. Land suitability classification in Indonesia and other developing countries currently uses a land suitability classification system according to the FAO land evaluation framework of 1976
Land use's success is heavily influenced by the fulfillment of requirements in land use. Mistakes in determining land use will affect the overall layout and have the potential to have a detrimental impact on the environment and the economy.

The benefits of this research can provide information to the public about the location of farmers' groups and agricultural superior commodity information in Soppeng Regency as well as a documentation facility for the Soppeng District Agriculture Office to know the location mapping and superior commodity data handled in the service of farmers' groups in Soppeng Regency.

2. Literature Review

Soppeng regency is dominated by agricultural land, both rice fields and not rice fields in 2017. The agricultural land area in Soppeng amounted to 97,972 ha, while non-agricultural land amounted to 52,028 ha. The farmland consists of rice fields and farmland instead of rice fields. The area of agricultural land in rice fields amounted to 29,081.8 ha or 19.39 percent of the total land area in Soppeng Regency. While the area of agricultural land is not rice fields amounting to 68,890.2 ha or 45.93 percent of the total land area in Soppeng Regency. This can be seen in Figure 1 and Table 1.

![Figure 1](image1.png)

**Table 1.** Area of agricultural land by sub-district and type in Soppeng district

| No | District         | Fields   | Addition Fields | Summary   |
|----|-----------------|----------|-----------------|-----------|
| 010| Marioriawo      | 3,030.9  | 17,693.4        | 20,724.3  |
| 020| Lalabata        | 3,571.0  | 5,057.0         | 8,628.0   |
| 030| Liliriaja       | 4,371.9  | 4,816.1         | 9,188.0   |
| 031| Ganra           | 3,911.0  | 1,481.0         | 5,392.0   |
| 032| Citta           | 400.2    | 3,267.5         | 3,667.7   |
| 040| Lilirilau       | 2,121.9  | 15,626.1        | 17,748.0  |
| 050| Donri-Donri     | 4,615.0  | 16,240.0        | 20,855.0  |
| 060| Marioriawa      | 7,061.8  | 4,707.2         | 11,769.0  |
|    | Total           | 29,083.7 | 68,888.3        | 97,972.0  |

In Table 1 it can be seen that the largest rice field is in Marioriawa Sub-district of 7,061.8 hectares, while the fewest is in the Citta glasses of 400.2 hectares.

From Figure 1b can see that every year the area of rice fields increases. The increase each year tends to be stable, ranging from 1-2 percent from the previous year. The increase in rice fields every year is due to the opening of new rice fields by the Soppeng Regency government in the last 5 years. The increase in rice fields can undoubtedly support the strengthening of national food self-sufficiency and the welfare of farmers, which is the priority of the development of Soppeng Regency.
3. Research Methodology

In agricultural surveys collected data on planting area or a number of trees, harvest area and productivity per unit area or a number of production trees. As a complement, also collected mutation data such as the area of the plant earlier in the month which according to the success rate, loss, and replacement of the plant at the end of the month. Each plant is also asked about its intensification activities[8].

To monitor its success and obstacles, it also collected data on the extent of pest and disease attacks and natural disasters. Its intensity measures each pest and disease attack. To assess the success of efforts to increase productivity per hectare also collected data on superior seed fertilizers and types of irrigation. Every beginning of the year also collected data on the area of rice fields and dry land according to its use and reports of agricultural tools available and used[9][10].

The analysis method is a procedural analysis that aims to know more clearly how the system works so that the system's advantages and disadvantages can be known. After conducting several analysis of the problems faced, the design of the system development process was proposed on the solution built to solve the problem and achieve the goals mentioned in the previous section[11].

Primary data collection through literature studies, interviews, and observations, software needs, digitization of maps using ArcView/QGIS software. QGIS version 3.14 (formerly known as Quantum GIS) is a desktop Geographic Information System (GIS) application that provides data display, editing, and analysis. QGIS allows users to create maps with multiple layers[12][13]. After QGIS 3.14 software is installed, the next stage is to build a database with MySQL, conducting system testing as the final stage in analyzing agricultural land suitability using Geographic Information System (GIS) in Soppeng Regency area[14]. Figure 2 shows the research flowchart.

4. Result and Discussion

Increasing food production to support the strengthening of national food self-sufficiency is one of the regional development priorities of Soppeng Regency by the region's potential. Therefore, land use for food crops, especially rice, continues to be pursued by increasing irrigation efforts so that in one year it can be planted several times.
Table 2. Rice field area according to sub-district and realization of rice planting in a year in Soppeng regency in 2017 (Ha)

| District | Rice planting | Not planted with rice | Sum |
|----------|----------------|-----------------------|-----|
|          | First | Twice | ≥ Three times | Planted by other plants | Not planted by other plants |       |
| 010 Marioriawo | 1.263,0 | 1.767,8 | 0,0 | 0,0 | 0,0 | 3.030,8 |
| 020 Lalabata | 25,0 | 2.636,0 | 910,0 | 0,0 | 0,0 | 3.571,0 |
| 030 Liliriaja | 0,0 | 4.342,0 | 18,0 | 10,0 | 0,0 | 4.370,0 |
| 031 Ganna | 0,0 | 3.911,0 | 0,0 | 0,0 | 0,0 | 3.911,0 |
| 032 Citta | 4,2 | 486,0 | 110,0 | 0,0 | 0,0 | 400,2 |
| 040 Lilirilau | 1.103,7 | 1.005,0 | 0,0 | 13,3 | 0,0 | 2.122,0 |
| 050 Donri-Donri | 275,0 | 4.340,0 | 0,0 | 0,0 | 0,0 | 4.615,0 |
| 060 Marioriawa | 291,0 | 1.727,0 | 4.925,0 | 46,0 | 72,8 | 7.061,8 |
| Total | 2.961,9 | 20.014,8 | 5.963,0 | 69,3 | 72,8 | 29.081,8 |

In Table 2 it can be seen that the rice fields that have the realization of planting more or equal to 3 (three) times there in Marioriawa sub-district of 4,925 hectares, Citta sub-district of 110 hectares. While other sub-districts did not experience the realization of planting three times or more.

In 2017 the largest irrigation rice fields area was in Marioriawa sub-district as 5,408 hectares, while the fewest are in the glasses Citta as roughly 353.2 hectares. The largest rain-ed rice fields area is in Marioriawa Sub-District of 1,635.7 hectares, and for Lalabata sub-district, which is at least 25 hectares.

The realization of rice planting in the rice fields of Marioriawa sub-district in 2017 can reach more than three plantings. This happens in both irrigation fields and rain-covered rice fields. Descriptively it can be stated that Marioriawa sub-district is the most likely sub-district to produce more agricultural production compared to other sub-districts.

The area of land instead of the rice fields of Soppeng Regency tends to fluctuate. Over the past five years, land is not the most widely used rice field as garden land. The land area instead of rice fields began to be used a small part for the country's forests in 2015. The area of land used for the country's forests continues to increase, reaching 19,602 hectares in 2017. The area of land, not rice fields from 2013 to 2017 has fluctuated before[7]. Figure 3 shows the Soppeng district administration map province of South Sulawesi.
5. Conclusion
The purpose of the research is to identify land use's suitability in the analysis of agricultural land suitability using geographical information systems in Soppeng regency area. It concluded that QGIS application is suitable for mapping the area of agricultural land in Soppeng district. From 2016 to 2017 there was a drastic reduction in the area of non-agricultural land. This is also in line with the increase in the area of rice fields or non-rice fields in 2017. One of the efforts to increase the productivity of farmers to come is by optimizing the government, resources and application of recommended technology components in a location and efficient manner, it is expected that the increase in farmers' income production, the expansion of employment opportunities, and the sustainability of the environment and natural resources can be achieved.

Acknowledgment
I would like to sincerely thank Prof. Dr. H. Imran Ismail, M.S. as chairman of AMIK Lamappapoleonro Soppeng foundation who has given full support and guidance so that this writing can be realized. As well as not forgetting the special thanks I gave to the Ministry of Research and Technology/National Research and Innovation Agency (Indonesia) for the research grant program of novice lecturers with contract number: No. 7/E/KPT/2020.

Figure 3. Soppeng district administration map province of South Sulawesi
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