Journal EnvironmentAsia
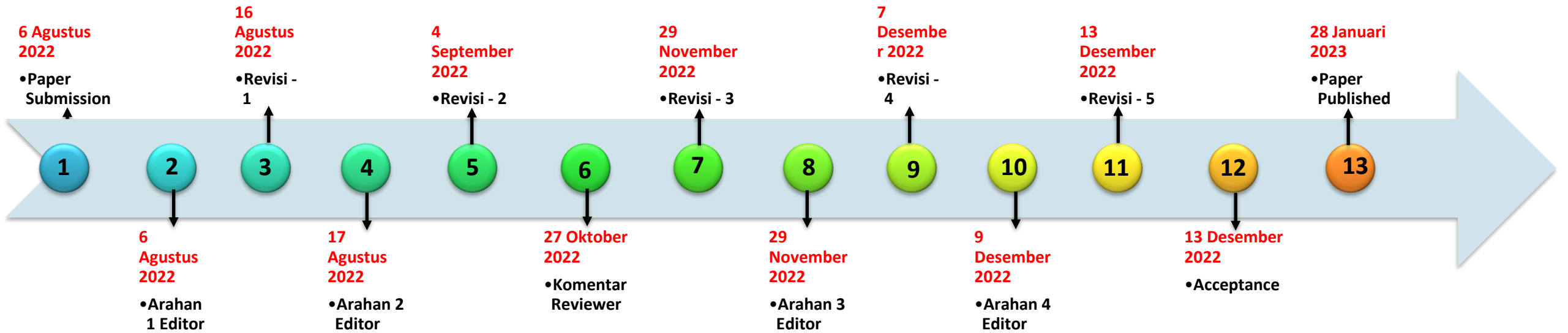
"THE UTILIZATION OF GEOGRAPHIC INFORMATION SYSTEMS (GIS) FOR THE SUITABILITY OF AGRO-TOURISM LAND"

6 Agustus 2022
- Paper Submission

16 Agustus 2022
- Revisi - 1

4 September 2022
- Revisi - 2

29 November 2022
- Revisi - 3

7 Desember 2022
- Revisi - 4

13 Desember 2022
- Revisi - 5

28 Januari 2023
- Paper Published

6 Agustus 2022
- Arahan 1 Editor

17 Agustus 2022
- Arahan 2 Editor

27 Oktober 2022
- Komentar Reviewer

29 November 2022
- Arahan 3 Editor

9 Desember 2022
- Arahan 4 Editor

13 Desember 2022
- Acceptance

UNM

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paper submission
33 pesan

Drs. H. Sukri Nyompa, SH, M.Si., Ph.D. UNM <sukrinyompa@unm.ac.id>   6 Agustus 2022 pukul 20.39
Kepada: environmentasiajournal.submit@gmail.com

Dear Editorial Team,

I am pleased to submit an original research article entitled "*The utilization of Geographic Information Systems (GIS) for the suitability of agro-tourism land*" for publication consideration in *EnvironmentAsia*. This manuscript has not been published and is not under consideration for publication elsewhere. We have no conflicts of interest to disclose. This research is fully funded by Universitas Negeri Makassar.

Thank you for your consideration,

Sincerely,

Assoc. Prof. Dr. Sukri Nyompa
Geography Department, Mathematics and Science Faculty,
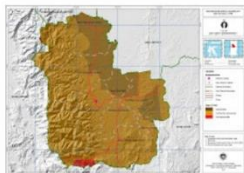Universitas Negeri Makassar, Makassar, Indonesia

6 lampiran

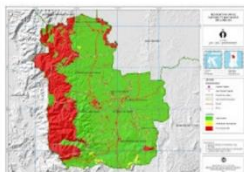**Fig 3. Recreation space suitability map by soil type.tif**
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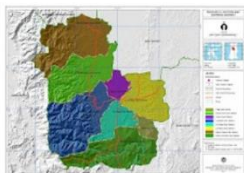**Fig 4. Recreation space suitability map by land use.tif**
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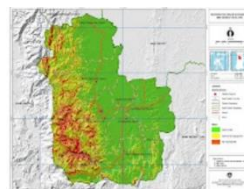**Fig 1. Research location map.tif**
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Fig 2. Suitability map of recreation space based on slope.tif
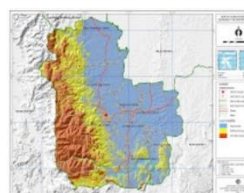3080K

Fig 5. Agro-tourism land suitability map in Soppeng district.tif
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REVIEW 1 - EDITOR

Please put the figure in the text. We will work on only one file.

[Kutipan teks disembunyikan]

HASIL REVISI 1

Drs. H. Sukri Nyompa, SH, M.Si., Ph.D. UNM <sukrinyompa@unm.ac.id>   16 Agustus 2022 pukul 21.18
Kepada: environmentAsia Journal <environmentasiajournal.submit@gmail.com>

Thank you very much. We have just integrated the Figures in one file.

[Kutipan teks disembunyikan]

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The utilization of Geographic Information Systems (GIS) for the suitability of agro-tourism land

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Abstract
Development of environmentally friendly tourism can be interpreted as development that does not damage the environment and uses land wisely. In terms, agrotourism is a tourism activity that explore and utilize the potential of the environment in it as a tourist attraction. This study aims to determine the agrotourism area by the physical conditions of the environment in Soppeng Regency, South Sulawesi, Indonesia. Determining the suitability of agrotourism areas using quantitative descriptive methods using overlay analysis techniques or stacking parameter maps (land use, soil type, and slope) that have been scored and weighted beforehand using the Arcgis 10.8 application. The results of the overlay produce a composite map and divide the area into three classifications, namely areas that are suitable, quite suitable, and not suitable. The suitable area is 72,794 Ha (53.52%), the suitable area is 34,726.96 Ha (25.61%) and the unsuitable area is 28,269.02 Ha (20.87%). Based on the results of the analysis of several parameters above, it shows that Soppeng Regency has the potential to be used as an agrotourism area which is also supported by the various types of agricultural activities in Soppeng Regency.

INTRODUCTION

The development of the tourism industry without paying attention to environmental impacts will certainly harm humans themselves. Therefore, environmental development needs to be developed not to damage the environment and provide knowledge to the wider community (Díez-Gutiérrez & Babri, 2020). The greater public knowledge about the environment, the better the impact will be felt (Gautam, 2020). This is because tourism can be a threat in the form of conservation area expansion that can damage protected ecosystems to disrupt the sustainability of tourism potentials (Canteiro et al., 2018).

Indonesia's diversity of tourism potential includes natural resource-based tourism, including rural and agricultural landscapes where tourism has its charm as a destination that can provoke an increase and turn the wheels of the economy, especially for the government and society (Situmorang et al., 2019). Rural tourism has now developed following the times where the main focus is locations that

are the main icons of natural scenery, agricultural land, and culture (Xiang et al., 2020). In simple terms, agrotourism is a tourism activity that utilizes the capabilities of agricultural land, processing production processes, and distributing production products in which there are activities to introduce the rural culture and preserve the environment (Kaswanto, 2015).

Exploring the potential of agrotourism in Soppeng Regency, South Sulawesi province, Indonesia has been explained about the intensity of spatial use aimed at planning and developing agrotourism areas and integrating tourism activities to support the preservation of technically irrigated agricultural land (Soppeng Regency Government, 2012). This has become one of the drivers of research on agrotourism development in the Soppeng Regency. Thus, the potential for agricultural tourism, nature conservation, and culture can be maintained to preserve nature and culture as a gift from God Almighty. It is an effort to promote general welfare for the community through the development of village tourism potential by utilizing the potential of the environment and land for the benefit of tourist attractions for the welfare of the local community (Soppeng Regency Government, 2019).

Various previous studies raised almost the same theme, namely agrotourism – traditional knowledge and rural biotechnology (Ciolac et al., 2015) and Agrotourism as prospects, interests, goals, and challenges in Nepal (Khanal & Shrestha, 2019). Therefore, in this research, the researchers intend to present information about the use of geographic information systems (GIS) to identify the suitability of agrotourism in Soppeng Regency, which is viewed from the physical aspect of the environment using the Overlay analysis technique (overlapping parameter maps) with the scoring and weighting method using the application. Arcgis 10.8

Diez-Gutierrez and Babri (Díez-Gutiérrez & Babri, 2020) studied the development of tourism that can harm the environment. One of the factors causing increased pollution around tourist attractions comes from tourist behavior. One way to provide information to tourists is by determining the right tourist route. This study concludes that policymakers should consider improving the transportation system.

Canteiro *et al* (Canteiro et al., 2018) revealed that the threat of environmental expansion would impact the tourism sector. This study uses the Tourism Impact Assessment (TIA) method by evaluating the environmental impacts associated with nature conservation areas. The result is that fifteen tourism activities affect four biological components (biodiversity, land cover, soil, and water).

Xiang *et al* (Xiang et al., 2020) stated that rural eco-tourism focuses on development by utilizing natural resources. Determination of standards using survey and evaluation methods in determining rural eco-tourism. This study uses the Decision Alternative Ratio Evaluation System (DARE) and the Delphi method. The research results in this scientific research show that natural conditions and the human condition are the core elements of rural eco-tourism resources.

Kaswanto (Kaswanto, 2015) studied the evaluation of agro-tourism based on four aspects, namely agriculture, tourism, beauty, and amenities (ATBA). That is, the development of natural tourism focuses on agriculture that is right for tourism. Spatial distribution of land use using Landsat image. Spatial distribution of land use using Landsat imagery. The spatial approach is used by combining the element values of each landscape. This study aims to design a land management scenario for agro-tourism using the ATBA method. At the same time, Chen (Chen, 2020) discusses the environmental impacts caused by changes in environmental ecosystems. The method used to determine environmental changes using (ESV) is to assess each ecosystem.

MATERIALS AND METHOD

The type of research used in this research is descriptive quantitative research. Quantitative descriptive research is a research method based on the philosophy of positivism or a perspective when understanding a fact-based on empirical data, where data analysis is more statistical (Creswell & Creswell, 2017). Quantitative descriptive research is also a conscious and systematic effort to
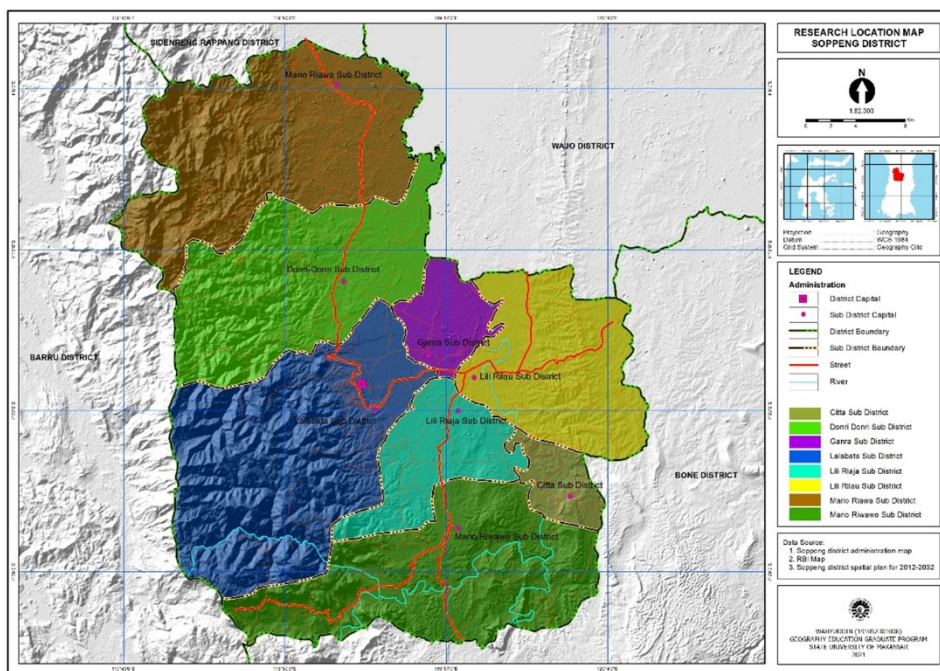
provide answers to a problem and or obtain more in-depth and broad-based information on an incident phenomenon using the stages of a quantitative approach.

Table 1. Types and sources of research data

No	Data	Data Type	Data Source
1	Administration Map	Primary Data	Related Agencies
2	Slope	Secondary Data	Observation and Dem Srtm
3	Type Of Soil	Secondary Data	Related Agencies
4	Land Use	Primary Data	Landsat 8 Image Of 2019

Research Sites

Soppeng Regency is located in South Sulawesi Province. It is divided into 8 sub-districts: Marioriwawo District, Lalabata District, Liliriaja District, Ganra District, Citta District, Lilirilau Donri-Donri District, and Marioriawa District. Marioriawa District is the largest sub-district, with an area of 320 km2 or about 21.3% of the total area of Soppeng Regency. Meanwhile, the Citta sub-district is the sub-district with the smallest area, which is only 40 km2 or 2.7 percent of the total area of Soppeng Regency. Soppeng Regency is geographically located at coordinates 4 6'00" - 4 32'00" South Latitude and 119° 47'18" - 120 06'13" East Longitude as shown in Fig 1 below.

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Fig 1 Fig.1 Research Location Map

Soppeng Regency boundaries include:
a. North side: Sidenreng Rappang Regency
b. East: Wajo Regency and Bone Regency
c. Southside: Bone Regency
d. West: Barru Regency

Soppeng Regency is surrounded by a vast mountainous landscape and a topography that varies from flat to steep with natural characteristics typical of the countryside. The research location has various agricultural and plantation resources and natural and artificial landscapes that have high enough potential to be used as agro-tourism objects.

Agrotourism Land Suitability Zone Analysis

Spatial analysis uses ArcGIS 10.8 software and overlay technique or parameter stacking after determining each criterion and scoring (Table 2 and Table 3). The spatial method is based on the slope, land use, and erosion sensitivity according to soil type.

Table 2. Assessment criteria and a recreational room suitability score

Aspects	Standards of Conformity	Criteria	Score
Land Use	There is no building structure and other vegetation other than the ground cover. The site is dominated by open land use.	fits	3
	The site is still quite dominated by open land use, but there are several structures and buildings and vegetation other than the ground cover.	Sufficiently Suitable	2
	Dominant site with Incompatible building	not suitable	1
Slope	0-8 % (Flat and Sloping)	Appropriate	3
	8-15 % (Slightly Steep)	Fairly Appropriate	2
	>15 % (Steep and Steep)	not suitable	1

*good=3, moderate=2, bad= 1, Source: (Hardjowigeno, 2007)

Table 3. Assessment criteria and conformity score sensitivity to erosion

Aspects	Standards of Conformity	Criteria	Score
Soil Type	Alluvial, Glei Planosol Hydromorphic Gray Soil, Literita Groundwater, Suitable Latosol	Suitable Latosol (Not Erosion Sensitive)	3
	Brown Forest Soil, Non Calcis Brown, Mediteran, Andosol, Laterit, grumosol, podsol, podsolik	Sufficiently (Sensitive erosion)	2
	Regosol, Litosol, organosol, renzina	Incompatible (Sensitive erosion)	1

*good=3, moderate=2, bad=1, Source: (Ministry of Agriculture, 1980)

Based on the assessment criteria and the score for the suitability of the recreation space above, a land suitability map for the designation of agrotourism areas in Soppeng was compiled. The determination of the classification level is as follows:

From the calculation of the scores for each parameter, the criteria for the suitability class were obtained. The results of the assessment of tourist areas are clarified as A (Appropriate), SA (Sufficiently Appropriate), and NA (Not Appropriate)

RESULTS AND DISCUSSION

Analysis of the Level of Suitability of Recreation Space based on The Slope of the Slope
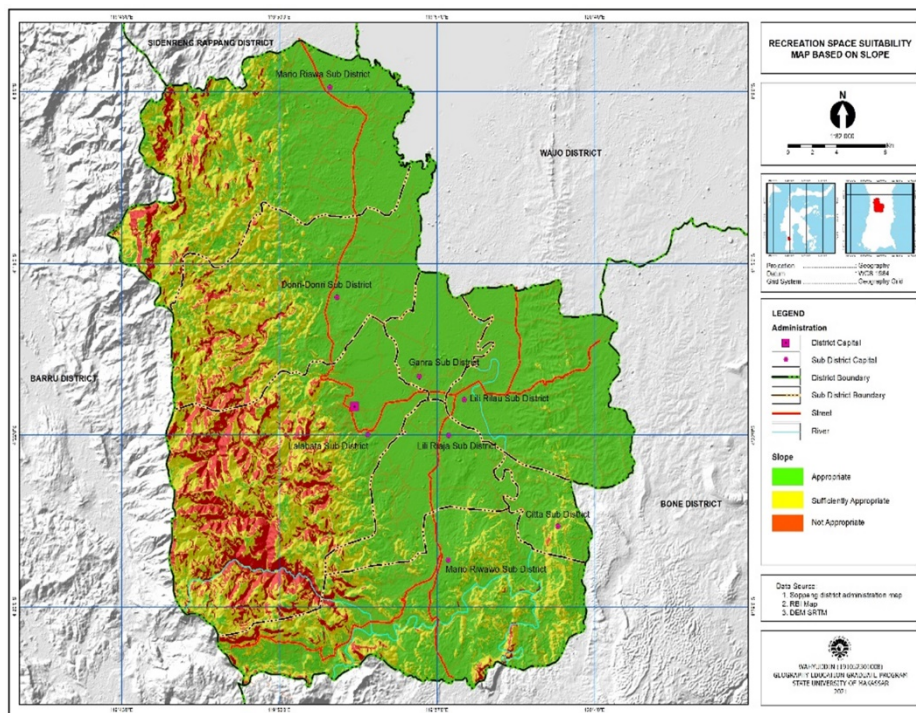
Slope data obtained from DEM SRTM 30 meters resolution. The results showed that the area that is suitable to be used as an agrotourism area has an area of 84.429,42 Ha (61,91%), while the area that is not suitable has an area of 13.099,35 Ha (9,61%) of the total area of Soppeng Regency. The results

of the analysis can be seen in Table 4. The distribution can be seen in Fig 2, which generally shows the appropriate criteria.

Table 4. Level of suitability based on slope

No	Classification	Slope (%)	Large	
			(Ha)	(%)
1	Appropriate	0-8	84.429,42	61,91
2	Sufficiently Appropriate	> 8-15	38.838,08	28,48
3	Not Appropriate	> 15	13.099,35	9,61
	Total		136.366	100

Source: Analysis results, 2021

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Fig 2. Suitability map of recreation space based on slope

Analysis of the level of suitability of recreation space based on soil type

Determination of recreation space based on soil type is used as one of the main parameters. Where the results of the analysis show that the classification is quite suitable, having the largest area, which is 106,639.46 Ha (78.2%) and the unsuitable classification has the smallest area of 1,415.2 (1.03%). More details can be seen in Table 5 and its spatial distribution in Fig. 3, where a fairly adequate classification dominates the level of suitability of the recreation space according to the gromusol and Mediterranean soil.

Table 5. Level of suitability by soil type

No	Classification	Type of Soil	Large	
			(Ha)	(%)
1	Appropriate	Aluvial	28.311,79	20,76
2	Sufficiently Appropriate	Gromusol	17.180,64	12,60
3		Mediteran	89.458,82	65,60
4	Not Appropriate	Regosol	88,10	0,06

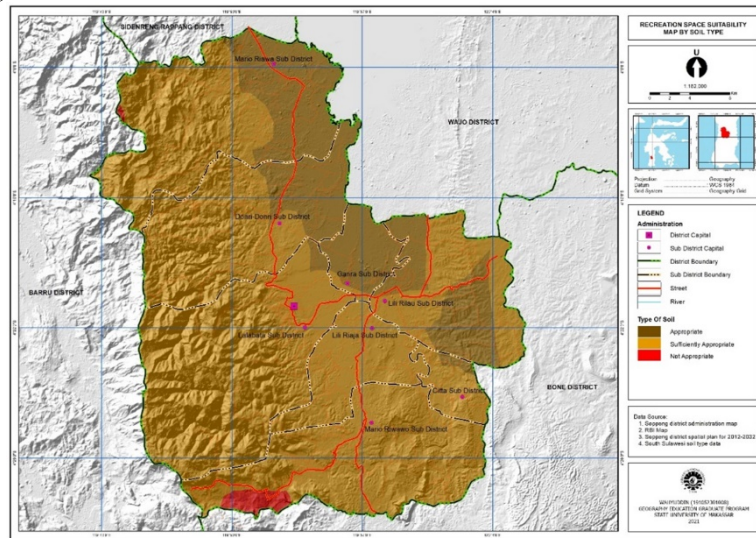|				
5		Litosol	1.327,10	0,97
	Total		136.366	100

Fig 3. Recreation space suitability map by soil type

Analysis of the level of suitability of recreation space based on land use

Image interpretation was carried out using Landsat 8 image data in 2019. Where the results of the analysis of the suitability of recreation space based on land use, the classification was obtained according to the largest area of 96,958.93 Ha (71.1%), and the criteria did not match the smallest area of 4,877.7 Ha (3,6%). More details can be seen in Table 6 and its spatial distribution in Fig 4. The level of suitability of recreational spaces is generally dominated by appropriate classification, so that in essence, Soppeng Regency has the potential to become a sustainable agro-tourism area.

Table 6. Level of suitability by land use

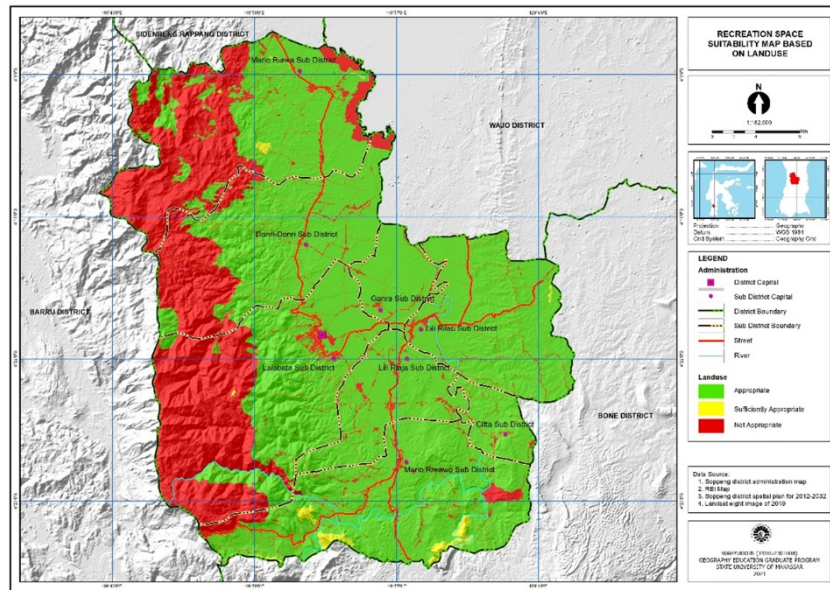| No	Classification	Landuse	Large	
			(Ha)	**(%)**
1	Appropriate	Field	10.001,97	7,33
2		garden	17.409,58	12,77
3		ricefield	28.564,92	20,95
4		Mixed garden	40.982,46	30,05
5	Sufficiently Appropriate	bushes and shrubs	1.280,54	0,94
6		forest	33.219,63	24,36
7	Not Appropriate	Body of water	1.430,45	1,05
8		settlement	3.477,25	2,55
	Total		136.366	100

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Fig 4. Recreation space suitability map by land use

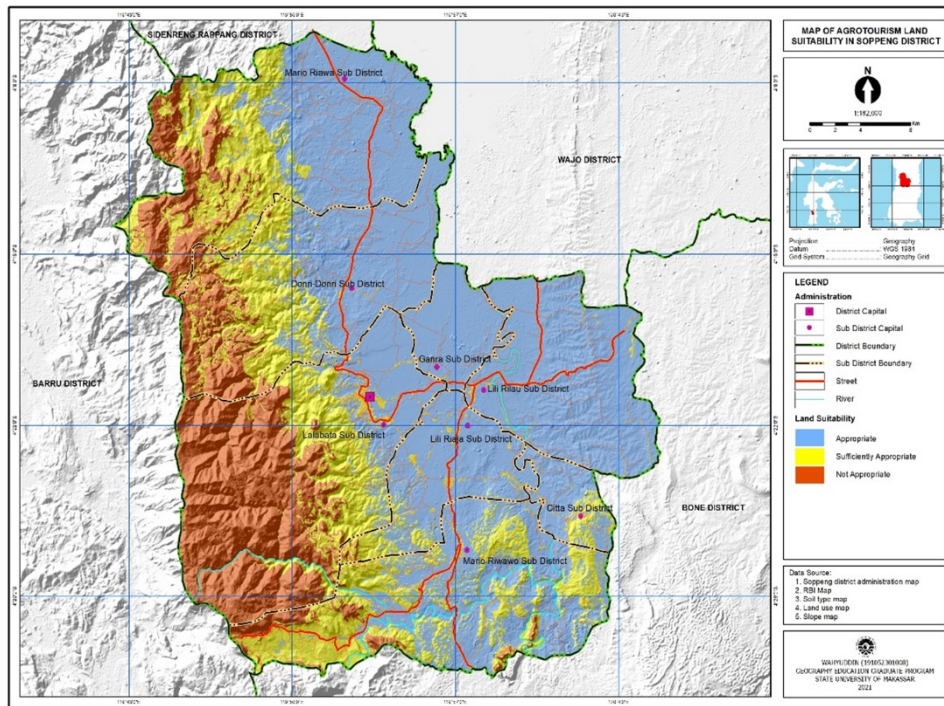**Analysis of Land Suitability for Agrotourism Areas**

Based on the results of the overlay analysis using the Arcgis 10.8 application using the three indicators above, the results of the suitability of agrotourism land were obtained, which were divided into three suitability zones, namely appropriate, quite suitable, and not suitable. The area suitable for agrotourism has the widest distribution, which is 72.794.28 Ha (53.52%), and the unsuitable classification has the smallest area of 28.269.02 Ha (20.87%). The results of the overlay analysis can be seen in Table 7.

Table 7. The wide distribution of overlayed agro-tourism areas

No	Classification	Large	
		(Ha)	(%)
1	Appropriate	72.983.02	53,52
2	Sufficiently Appropriate	34.918.65	25,61
3	Not Appropriate	28.464.33	20,87
	Total	136.366	100

Source: Analysis results, 2021

The identification of the spatial distribution of land suitability for agrotourism in the Soppeng Regency can be seen in Fig 5. In general, the Soppeng Regency area is dominated by area criteria suitable for agrotourism. Based on the results of the analysis and field observations, it is shown that the existing conditions in Soppeng Regency are suitable as an agro-tourism planning area. Given the abundant agro-tourism potential of Soppeng Regency, and currently has received attention from the district government, as evidenced by the existence of the Soppeng Regency Regional Regulation (Soppeng Regency Government, 2012).

Fig 5. Agro-tourism land suitability map in Soppeng district

Identification of land suitability for agro-tourism is carried out to find out whether each area in Soppeng Regency has the potential for agrotourism development and to find out the various problems that exist. This is very important to study because, in general, the land contained in the agrotourism area includes natural resources that have a lot of potential and benefits to accommodate the socio-economic activities of the community in maximizing the environment. The current rural environment is more likely to develop towards educational tourism. This is good so that the general public can know the life and activities of farmers and create a positive image of agriculture for the next generation (Petroman et al., 2016). Thus, the results of this education can add to the public's knowledge about marketing strategies for agricultural products, of course, with the government and the community (Liang et al., 2020).

The results of the suitability for agrotourism areas based on the slope show beautiful views, especially towards the hills, which provide more visual value to attract the attention of visitors. The area of Soppeng Regency, especially in sloping to steep areas and close to resident villages, has a great opportunity to develop development and cultivation activities related to agrotourism (Gunarto, 2017). At the same time, the steep area is very important to pay attention to because this area is very prone to erosion to landslides which can endanger site users because currently there have been many minor damages due to soil erosion caused by land degradation (Huang et al., 2016). Therefore, planting plants in mountainous areas with steep slopes will provide stability to the slopes that can withstand soil movement if erosion occurs (Grima et al., 2020).

Determination of agrotourism areas is not only based on the slope. But also in terms of soil type. The results of the identification of the area's suitability found that the soil types scattered in Soppeng Regency are quite good for use as an agrotourism area because this area has good fertility and humidity levels, especially in lowland areas. The relationship between soil type and agrotourism is closely related, where soil type is the main factor of soil fertility whose function is vital for plant growth, but highland areas will usually affect soil fertility due to different agricultural management practices, regardless of soil type (Tran et al., 2021).

The results of Landsat 8 image analysis in 2019 Soppeng Regency has agro-tourism potential seen from land use. In general, it consists of forests, mixed gardens, fields, plantations, settlements, rice fields, shrubs, and bodies of water. The potential of this land is very likely to become an agrotourism

attraction even though it has not been fully utilized optimally. Therefore, it is necessary to assess the suitability of appropriate land use and implement policies by the government and involve every stakeholder in order to be able to reach the right decision-making for the sustainability of agricultural tourism (Lazoglou & Angelides, 2020).

Although land use has a great opportunity as a determinant aspect of agrotourism, if its management is not regulated in such a way, it will not get maximum results. For this reason, this research can be used as a reference so that land use in Soppeng Regency can be more focused so that land use management can be cultivated and carried out optimally in order to preserve the environment, of course with the cooperation of the community and the government as the core of environmental management (Musavengane, 2019).

In addition to slopes, soil types, and land use, hydrological factors also influence soil and plant moisture as the basic things that support human life and development (Zhou & Wang, 2019). These factors will certainly greatly affect the productivity level of the agro-tourism area because the location of Soppeng Regency is also located along the watershed so that it has the potential to irrigate the soil and crops around it (Soppeng Regency Government, 2017).

This study found that, in general, Soppeng Regency has the potential for agro-tourism development based on the analysis results using the Overlay technique that combines each of the parameters used, namely soil type, land use, etc, and slope. Furthermore, a land suitability map was made for agrotourism areas in Soppeng Regency. The overlay results produce a composite map and divide the area into three land suitability areas, namely suitable, moderately suitable, and inappropriate areas. So that in essence Soppeng Regency is suitable for agro-tourism development.

The results of the analysis can be used as an agrotourism development plan in accordance with the current conditions and development of the village. Rural tourism can contribute to the development of agro-tourism that is tailored to the objectives of sustainable regional development and contributes to cultural, economic, and social development (Kastenholz et al., 2018).

Theoretically, the development of agrotourism certainly requires tourist attractions, both natural and artificial. For the development of agrotourism in Soppeng Regency, tourist attraction aspects already exist, consisting of agricultural land, natural scenery accompanied by biodiversity. The diversity of flora and fauna has the economic potential to be marketed as a promising agro-tourism attraction (Navarro-Martínez et al., 2020). However, these tourism potentials require maintenance that pays attention to sustainable and culturally valuable ecosystems (Chen, 2020).

Efforts to develop agrotourism in Soppeng Regency take several policies which will later be used as a guide in implementing agrotourism. The designation of agrotourism areas has been determined which is located in Mariolau Village and Gattareng Village in Marioriwawo District (Soppeng Regency Government, 2012). Based on the physical analysis of the land in this study, the location is in reasonably good criteria because it needs several conditions in developing agrotourism areas because it is located in a varied topography. But these limiting factors can be addressed by planting conservation plants that can prevent landslides and managing agricultural land that pays attention to environmental aspects. This limiting factor also requires cooperation from various parties so that in the future, there will be no overlapping interests that can damage the development of agrotourism areas in Soppeng Regency.

CONCLUSION

Soppeng Regency, South Sulawesi province, Indonesia has a natural beauty in the form of a mountainous area and many agricultural crop commodities, which are quite abundant, making this area have agrotourism potentials that are feasible to be developed. Based on the results of data analysis using the overlay technique, it shows that suitable criteria for agrotourism areas dominate Soppeng Regency in general. However, in identifying the suitability of agro-tourism in this research, it is still not perfect due to the limitations of the data analysis used. Therefore, for similar research in the future, it is hoped that it will be able to identify the suitability of agrotourism viewed from

various factors (physical, biophysical, social, and economic) and, most importantly, reach the stage of planning the agrotourism landscape.

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The Utilization of Geographic Information Systems (GIS) for the Suitability of Agro-tourism Land

revised

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Abstract

Development of environmentally friendly tourism can be interpreted as development that does not damage the environment and uses land wisely. In terms, agrotourism is a tourism activity that explore and utilize the potential of the environment in it as a tourist attraction. This study aims to determine the agrotourism area by the physical conditions of the environment in Soppeng Regency, South Sulawesi, Indonesia. Determining the suitability of agrotourism areas using quantitative descriptive methods using overlay analysis techniques or stacking parameter maps (land use, soil type, and slope) that have been scored and weighted beforehand using the Arcgis 10.8 application. The results of the overlay produce a composite map and divide the area into three classifications, namely areas that are suitable, quite suitable, and not suitable. The suitable area is 72,794 Ha (53.52%), the suitable area is 34,726.96 Ha (25.61%) and the unsuitable area is 28,269.02 Ha (20.87%). Based on the results of the analysis of several parameters above, it shows that Soppeng Regency has the potential to be used as an agrotourism area which is also supported by the various types of agricultural activities in Soppeng Regency.

Keywords: Land Suitability; Geographic Information System (GIS); Land Suitability; Agrotourism

1. Introduction

The development of the tourism industry without paying attention to environmental impacts will certainly harm humans themselves. Therefore, environmental development needs to be developed not to damage the environment and provide knowledge to the wider community (Díez-Gutiérrez & Babri, 2020). The greater public knowledge about the environment, the better the impact will be felt (Gautam, 2020). This is because tourism can be a threat in the form of conservation area expansion that can damage protected ecosystems to disrupt the sustainability of tourism potentials (Canteiro et al., 2018).

Indonesia's diversity of tourism potential includes natural resource-based tourism, including rural and agricultural landscapes where tourism has its charm as a destination that can provoke an increase and turn the wheels of the economy, especially for the government and society (Situmorang et al., 2019). Rural tourism has now developed following the times where the main focus is locations that are the main icons of natural scenery, agricultural land, and culture (Xiang et al., 2020). In simple terms, agrotourism is a tourism activity that utilizes the capabilities of agricultural land, processing production processes, and distributing production products in which there are activities to introduce the rural culture and preserve the environment (Kaswanto, 2015).

Exploring the potential of agrotourism in Soppeng Regency, South Sulawesi province, Indonesia has been explained about the intensity of spatial use aimed at planning and developing agrotourism

areas and integrating tourism activities to support the preservation of technically irrigated agricultural land (Soppeng Regency Government, 2012). This has become one of the drivers of research on agrotourism development in the Soppeng Regency. Thus, the potential for agricultural tourism, nature conservation, and culture can be maintained to preserve nature and culture as a gift from God Almighty. It is an effort to promote general welfare for the community through the development of village tourism potential by utilizing the potential of the environment and land for the benefit of tourist attractions for the welfare of the local community (Soppeng Regency Government, 2019).

Various previous studies raised almost the same theme, namely agrotourism – traditional knowledge and rural biotechnology (Ciolac et al., 2015) and Agrotourism as prospects, interests, goals, and challenges in Nepal (Khanal & Shrestha, 2019). Therefore, in this research, the researchers intend to present information about the use of geographic information systems (GIS) to identify the suitability of agrotourism in Soppeng Regency, which is viewed from the physical aspect of the environment using the Overlay analysis technique (overlapping parameter maps) with the scoring and weighting method using the application. Arcgis 10.8

Diez-Gutierrez and Babri (2020) studied the development of tourism that can harm the environment. One of the factors causing increased pollution around tourist attractions comes from tourist behavior. One way to provide information to tourists is by determining the right tourist route. This study concludes that policymakers should consider improving the transportation system.

Canteiro *et al* (Canteiro et al., 2018) revealed that the threat of environmental expansion would impact the tourism sector. This study uses the Tourism Impact Assessment (TIA) method by evaluating the environmental impacts associated with nature conservation areas. The result is that fifteen tourism activities affect four biological components (biodiversity, land cover, soil, and water).

Xiang *et al* (2020) stated that rural eco-tourism focuses on development by utilizing natural resources. Determination of standards using survey and evaluation methods in determining rural eco-tourism. This study uses the Decision Alternative Ratio Evaluation System (DARE) and the Delphi method. The research results in this scientific research show that natural conditions and the human condition are the core elements of rural eco-tourism resources.

Kaswanto (2015) studied the evaluation of agro-tourism based on four aspects, namely agriculture, tourism, beauty, and amenities (ATBA). That is, the development of natural tourism focuses on agriculture that is right for tourism. Spatial distribution of land use using Landsat image. Spatial distribution of land use using Landsat imagery. The spatial approach is used by combining the element values of each landscape. This study aims to design a land management scenario for agro-tourism using the ATBA method. At the same time, Chen (2020) discusses the environmental impacts caused by changes in environmental ecosystems. The method used to determine environmental changes using (ESV) is to assess each ecosystem.

2. Materials and Method

The type of research used in this research is descriptive quantitative research. Quantitative descriptive research is a research method based on the philosophy of positivism or a perspective when understanding a fact-based on empirical data, where data analysis is more statistical (Creswell & Creswell, 2017). Quantitative descriptive research is also a conscious and systematic effort to provide answers to a problem and or obtain more in-depth and broad-based information on an incident phenomenon using the stages of a quantitative approach.

Table 1. Types and sources of research data

No	Data	Data Type	Data Source
1	Administration	Primary Data	Related Agencies

	Map		
2	Slope	Secondary Data	Observation and Dem Srtm
3	Type Of Soil	Secondary Data	Related Agencies
4	Land Use	Primary Data	Landsat 8 Image Of 2019

2.1. Research sites

Soppeng Regency is located in South Sulawesi Province. It is divided into 8 sub-districts: Marioriwawo District, Lalabata District, Liliriaja District, Ganra District, Citta District, Lilirilau Donri-Donri District, and Marioriawa District. Marioriawa District is the largest sub-district, with an area of 320 km2 or about 21.3% of the total area of Soppeng Regency. Meanwhile, the Citta sub-district is the sub-district with the smallest area, which is only 40 km2 or 2.7 percent of the total area of Soppeng Regency. Soppeng Regency is geographically located at coordinates 4 6'00" - 4 32'00" South Latitude and 119° 47'18" - 120 06'13" East Longitude as shown in Fig 1 below.
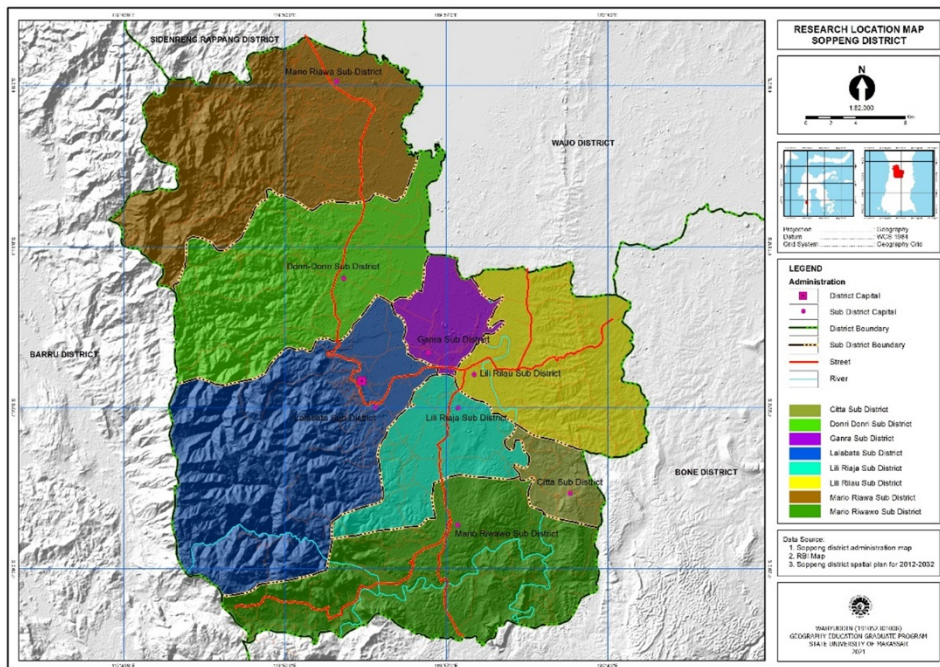

Figure 1. Research location map

Soppeng Regency boundaries include:
a. North side: Sidenreng Rappang Regency
b. East: Wajo Regency and Bone Regency
c. Southside: Bone Regency
d. West: Barru Regency

Soppeng Regency is surrounded by a vast mountainous landscape and a topography that varies from flat to steep with natural characteristics typical of the countryside. The research location has various agricultural and plantation resources and natural and artificial landscapes that have high enough potential to be used as agro-tourism objects.

2.2. Agrotourism Land Suitability Zone Analysis

Spatial analysis uses ArcGIS 10.8 software and overlay technique or parameter stacking after determining each criterion and scoring (Table 2 and Table 3). The spatial method is based on the slope, land use, and erosion sensitivity according to soil type.

Table 2. Assessment criteria and a recreational room suitability score

Aspects	Standards of Conformity	Criteria	Score
Land Use	There is no building structure and other vegetation other than the ground cover. The site is dominated by open land use.	fits	3
	The site is still quite dominated by open land use, but there are several structures and buildings and vegetation other than the ground cover.	Sufficiently Suitable	2
	Dominant site with Incompatible building	not suitable	1
Slope	0-8 % (Flat and Sloping)	Appropriate	3
	8-15 % (Slightly Steep)	Fairly Appropriate	2
	>15 % (Steep and Steep)	not suitable	1

*good=3, moderate=2, bad= 1, Source: (Hardjowigeno, 2007)

Table 3. Assessment criteria and conformity score sensitivity to erosion

Aspects	Standards of Conformity	Criteria	Score
Soil Type	Alluvial, Glei Planosol Hydromorphic Gray Soil, Literita Groundwater, Suitable Latosol	Suitable Latosol (Not Erosion Sensitive)	3
	Brown Forest Soil, Non Calcis Brown, Mediteran, Andosol, Laterit, grumosol, podsol, podsolik	Sufficiently (Sensitive erosion)	2
	Regosol, Litosol, organosol, renzina	Incompatible (Sensitive erosion)	1

*good=3, moderate=2, bad=1, Source: (Ministry of Agriculture, 1980)

Based on the assessment criteria and the score for the suitability of the recreation space above, a land suitability map for the designation of agrotourism areas in Soppeng was compiled. The determination of the classification level is as follows:

From the calculation of the scores for each parameter, the criteria for the suitability class were obtained. The results of the assessment of tourist areas are clarified as A (Appropriate), SA (Sufficiently Appropriate), and NA (Not Appropriate)

3. Results and Discussion

3.1. *Analysis of the level of suitability of recreation space based on the slope of the slope*

Slope data obtained from DEM SRTM 30 meters resolution. The results showed that the area that is suitable to be used as an agrotourism area has an area of 84.429,42 Ha (61,91%), while the area that is not suitable has an area of 13.099,35 Ha (9,61%) of the total area of Soppeng Regency.

The results of the analysis can be seen in Table 4. The distribution can be seen in Fig 2, which generally shows the appropriate criteria.

Table 4. Level of suitability based on slope

No	Classification	Slope (%)	Large	
			(Ha)	(%)
1	Appropriate	0-8	84.429,42	61,91
2	Sufficiently Appropriate	> 8-15	38.838,08	28,48
3	Not Appropriate	> 15	13.099,35	9,61
	Total		136.366	100

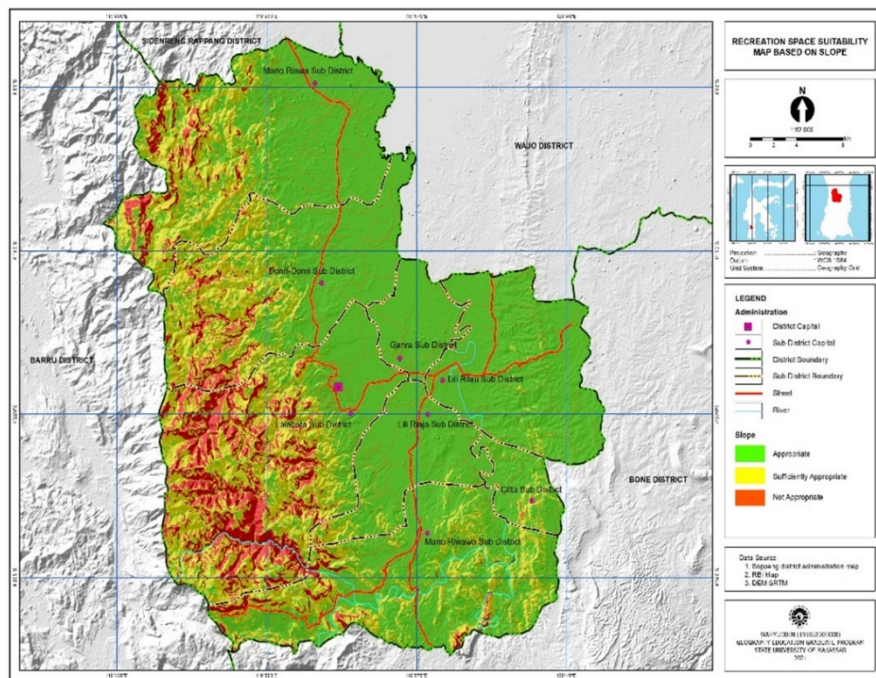Source: Analysis results, 2021

Figure 2. Suitability map of recreation space based on slope

3.2.   Analysis of the level of suitability of recreation space based on soil type

Determination of recreation space based on soil type is used as one of the main parameters. Where the results of the analysis show that the classification is quite suitable, having the largest area, which is 106,639.46 Ha (78.2%) and the unsuitable classification has the smallest area of 1,415.2 (1.03%). More details can be seen in Table 5 and its spatial distribution in Fig. 3, where a fairly adequate classification dominates the level of suitability of the recreation space according to the gromusol and Mediterranean soil.

Table 5. Level of suitability by soil type

No	Classification	Type of Soil	Large

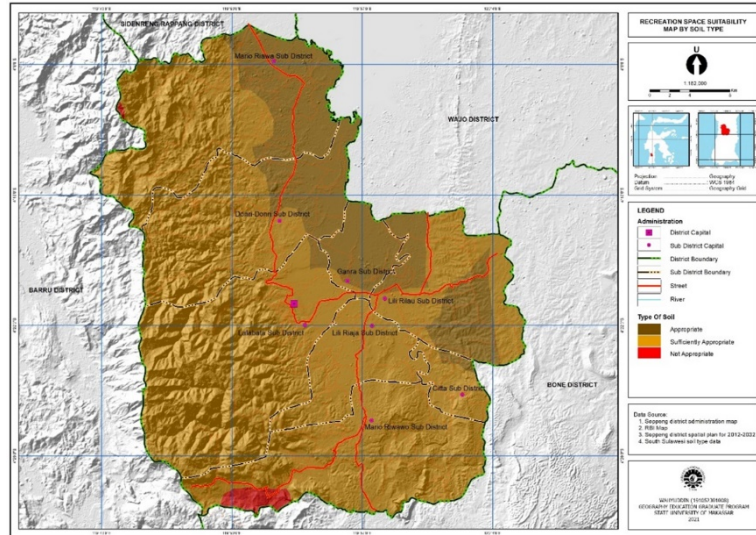|			(Ha)	(%)
1	Appropriate	Aluvial	28.311,79	20,76
2	Sufficiently Appropriate	Gromusol	17.180,64	12,60
3		Mediteran	89.458,82	65,60
4	Not Appropriate	Regosol	88,10	0,06
5		Litosol	1.327,10	0,97
	Total		136.366	100

Source: Analysis results, 2021

Figure 3. Recreation space suitability map by soil type

3.3. *Analysis of the level of suitability of recreation space based on land use*

Image interpretation was carried out using Landsat 8 image data in 2019. Where the results of the analysis of the suitability of recreation space based on land use, the classification was obtained according to the largest area of 96,958.93 Ha (71.1%), and the criteria did not match the smallest area of 4,877.7 Ha (3,6%). More details can be seen in Table 6 and its spatial distribution in Fig 4. The level of suitability of recreational spaces is generally dominated by appropriate classification, so that in essence, Soppeng Regency has the potential to become a sustainable agro-tourism area.

Table 6. Level of suitability by land use

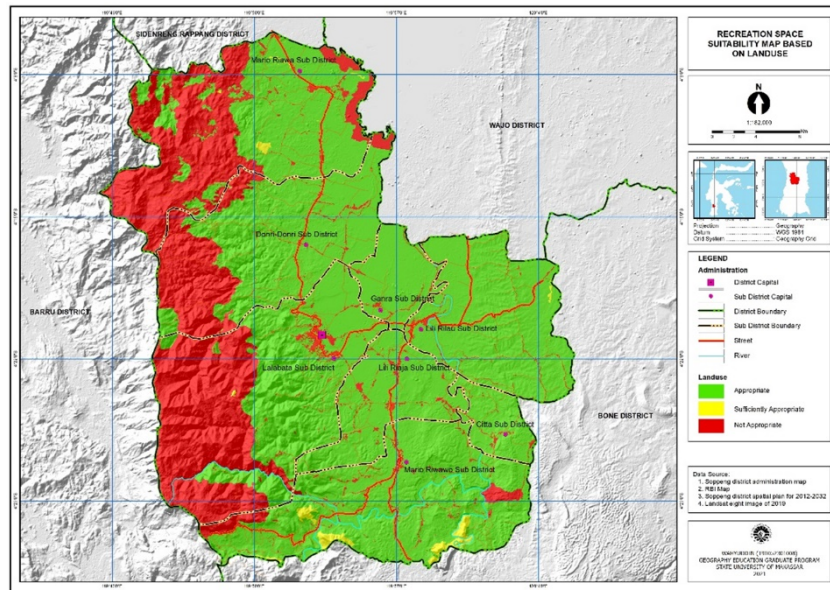| No	Classification	Landuse	Large	
			(Ha)	(%)
1	Appropriate	Field	10.001,97	7,33
2		garden	17.409,58	12,77
3		ricefield	28.564,92	20,95
4		Mixed garden	40.982,46	30,05
5	Sufficiently Appropriate	bushes and shrubs	1.280,54	0,94
6		forest	33.219,63	24,36
7	Not Appropriate	Body of water	1.430,45	1,05
8		settlement	3.477,25	2,55
	Total		136.366	100

Source: Analysis results, 2021

Figure 4. Recreation space suitability map by land use

3.4.   Analysis of Land Suitability for Agrotourism Areas

Based on the results of the overlay analysis using the Arcgis 10.8 application using the three indicators above, the results of the suitability of agrotourism land were obtained, which were divided into three suitability zones, namely appropriate, quite suitable, and not suitable. The area suitable for agrotourism has the widest distribution, which is 72.794.28 Ha (53.52%), and the unsuitable classification has the smallest area of 28.269.02 Ha (20.87%). The results of the overlay analysis can be seen in Table 7.

Table 7. The wide distribution of overlayed agro-tourism areas

No	Classification	Large	
		(Ha)	(%)
1	Appropriate	72.983.02	53,52
2	Sufficiently Appropriate	34.918.65	25,61
3	Not Appropriate	28.464.33	20,87
	Total	136.366	100

Source: Analysis results, 2021

The identification of the spatial distribution of land suitability for agrotourism in the Soppeng Regency can be seen in Fig 5. In general, the Soppeng Regency area is dominated by area criteria suitable for agrotourism. Based on the results of the analysis and field observations, it is shown that the existing conditions in Soppeng Regency are suitable as an agro-tourism planning area. Given the abundant agro-tourism potential of Soppeng Regency, and currently has received attention from the district government, as evidenced by the existence of the Soppeng Regency Regional Regulation (Soppeng Regency Government, 2012).
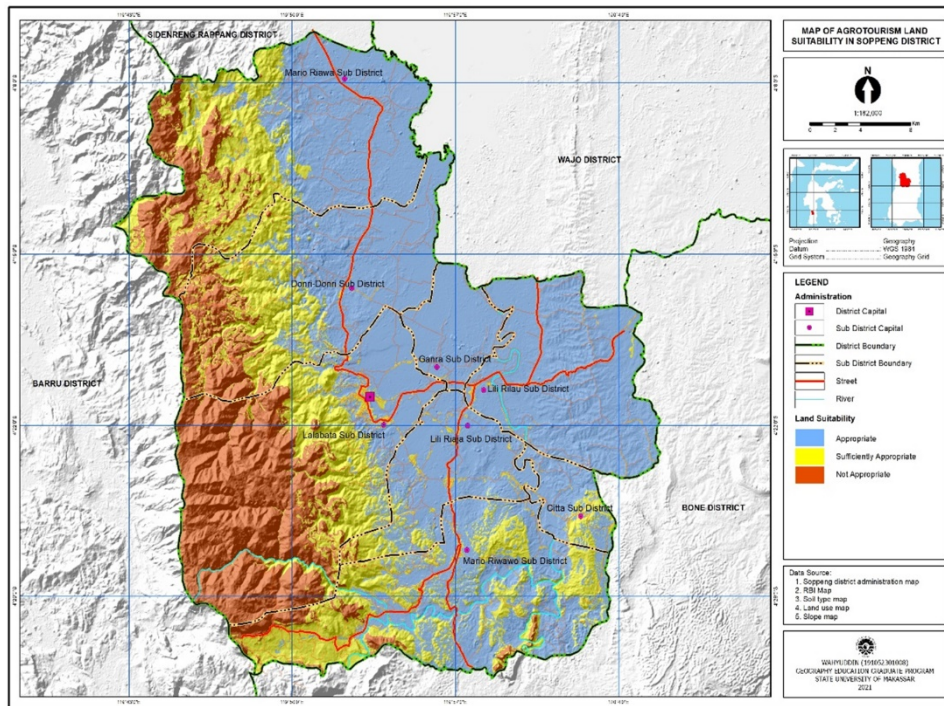
Figure 5. Agro-tourism land suitability map in Soppeng district

Identification of land suitability for agro-tourism is carried out to find out whether each area in Soppeng Regency has the potential for agrotourism development and to find out the various problems that exist. This is very important to study because, in general, the land contained in the agrotourism area includes natural resources that have a lot of potential and benefits to accommodate the socio-economic activities of the community in maximizing the environment. The current rural environment is more likely to develop towards educational tourism. This is good so that the general public can know the life and activities of farmers and create a positive image of agriculture for the next generation (Petroman et al., 2016). Thus, the results of this education can add to the public's knowledge about marketing strategies for agricultural products, of course, with the government and the community (Liang et al., 2020).

The results of the suitability for agrotourism areas based on the slope show beautiful views, especially towards the hills, which provide more visual value to attract the attention of visitors. The area of Soppeng Regency, especially in sloping to steep areas and close to resident villages, has a great opportunity to develop development and cultivation activities related to agrotourism (Gunarto, 2017). At the same time, the steep area is very important to pay attention to because this area is very prone to erosion to landslides which can endanger site users because currently there have been many minor damages due to soil erosion caused by land degradation (Huang et al., 2016). Therefore, planting plants in mountainous areas with steep slopes will provide stability to the slopes that can withstand soil movement if erosion occurs (Grima et al., 2020).

Determination of agrotourism areas is not only based on the slope. But also in terms of soil type. The results of the identification of the area's suitability found that the soil types scattered in Soppeng Regency are quite good for use as an agrotourism area because this area has good fertility and humidity levels, especially in lowland areas. The relationship between soil type and agrotourism is closely related, where soil type is the main factor of soil fertility whose function is vital for plant growth, but highland areas will usually affect soil fertility due to different agricultural management practices, regardless of soil type (Tran et al., 2021).

The results of Landsat 8 image analysis in 2019 Soppeng Regency has agro-tourism potential seen from land use. In general, it consists of forests, mixed gardens, fields, plantations, settlements, rice fields, shrubs, and bodies of water. The potential of this land is very likely to become an

agrotourism attraction even though it has not been fully utilized optimally. Therefore, it is necessary to assess the suitability of appropriate land use and implement policies by the government and involve every stakeholder in order to be able to reach the right decision-making for the sustainability of agricultural tourism (Lazoglou & Angelides, 2020).

Although land use has a great opportunity as a determinant aspect of agrotourism, if its management is not regulated in such a way, it will not get maximum results. For this reason, this research can be used as a reference so that land use in Soppeng Regency can be more focused so that land use management can be cultivated and carried out optimally in order to preserve the environment, of course with the cooperation of the community and the government as the core of environmental management (Musavengane, 2019).

In addition to slopes, soil types, and land use, hydrological factors also influence soil and plant moisture as the basic things that support human life and development (Zhou & Wang, 2019). These factors will certainly greatly affect the productivity level of the agro-tourism area because the location of Soppeng Regency is also located along the watershed so that it has the potential to irrigate the soil and crops around it (Soppeng Regency Government, 2017).

This study found that, in general, Soppeng Regency has the potential for agro-tourism development based on the analysis results using the Overlay technique that combines each of the parameters used, namely soil type, land use, etc, and slope. Furthermore, a land suitability map was made for agrotourism areas in Soppeng Regency. The overlay results produce a composite map and divide the area into three land suitability areas, namely suitable, moderately suitable, and inappropriate areas. So that in essence Soppeng Regency is suitable for agro-tourism development.

The results of the analysis can be used as an agrotourism development plan in accordance with the current conditions and development of the village. Rural tourism can contribute to the development of agro-tourism that is tailored to the objectives of sustainable regional development and contributes to cultural, economic, and social development (Kastenholz et al., 2018).

Theoretically, the development of agrotourism certainly requires tourist attractions, both natural and artificial. For the development of agrotourism in Soppeng Regency, tourist attraction aspects already exist, consisting of agricultural land, natural scenery accompanied by biodiversity. The diversity of flora and fauna has the economic potential to be marketed as a promising agro-tourism attraction (Navarro-Martínez et al., 2020). However, these tourism potentials require maintenance that pays attention to sustainable and culturally valuable ecosystems (Chen, 2020).

Efforts to develop agrotourism in Soppeng Regency take several policies which will later be used as a guide in implementing agrotourism. The designation of agrotourism areas has been determined which is located in Mariolau Village and Gattareng Village in Marioriwawo District (Soppeng Regency Government, 2012). Based on the physical analysis of the land in this study, the location is in reasonably good criteria because it needs several conditions in developing agrotourism areas because it is located in a varied topography. But these limiting factors can be addressed by planting conservation plants that can prevent landslides and managing agricultural land that pays attention to environmental aspects. This limiting factor also requires cooperation from various parties so that in the future, there will be no overlapping interests that can damage the development of agrotourism areas in Soppeng Regency.

4. Conclusion

Soppeng Regency, South Sulawesi province, Indonesia has a natural beauty in the form of a mountainous area and many agricultural crop commodities, which are quite abundant, making this area have agrotourism potentials that are feasible to be developed. Based on the results of data analysis using the overlay technique, it shows that suitable criteria for agrotourism areas dominate Soppeng Regency in general. However, in identifying the suitability of agro-tourism in this research, it is still not perfect due to the limitations of the data analysis used. Therefore, for similar research in the future, it is hoped that it will be able to identify the suitability of agrotourism viewed from

various factors (physical, biophysical, social, and economic) and, most importantly, reach the stage of planning the agrotourism landscape.

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REVIEW 3 - REVIEWER

Drs. H. Sukri Nyompa, SH, M.Si., Ph.D. UNM <sukrinyompa@unm.ac.id>

Notification from EnvironmentAsia Journal

1 pesan

MS: 2022-9-4-053
Title: The Utilization of Geographic Information Systems (GIS) for the Suitability of Agro-tourism Land

Dear Author,
According to your manuscript submission to EnvironmentAsia Journal, We have received the evaluation results from our reviewers on the above-mentioned manuscript.
We considered that the manuscript should be **revised.**
I hope the reviewers comments in the attached files are of help to you for the improvement of the manuscript. You are also asked to carefully consider the reviewer comments and submit a list of responses to the comments and highlight where your corrections are in your manuscript.

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Paper in a journal
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Report
Office of Natural Resources and Environmental Policy and Planning. Songkhla Lake Basin development project: review of critical issues for Songkhla Lake Basin development 2013-2016 final report. Bangkok, Thailand. 2011.

Book
Evans JD. Straightforward statistics for the behavioral sciences. Brooks/Cole Publishing, Pacific Grove, California, USA. 1996.

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Reviewer I

Consideration Issue	Comments/Suggestion for improvement
1. Title	
2. Abstract	
3. Introduction	The introduction in general is good, but in this section, it is necessary to add the condition of agro-tourism in Soppeng Regency. The conditions in question can be in the form of what plants are being cultivated, the number of visitors, or others so that they can be linked to the results of the research.
4. Materials and Methods	The actual number of parameters can still be added again. But with 3 parameters is good enough.
5. Results	The research results are quite good. In this section, it is necessary to have 1 or 2 photos from the location that present the physical conditions at the research location so that readers will know more about the conditions in the field.
6. Discussion and conclusion	In the results and discussion section, it is necessary to mention what the limiting factors were found in each land suitability class. Then it can also be added how the spatial distribution of each land suitability class has been found and associated with the 3 indicators used.
7. References and citations	
8. Others	In the Acknowledgment section, there are still blank sections. Please complete.

Reviewer II

Consideration Issue	Comments/Suggestion for improvement
1. Title	
2. Abstract	
3. Introduction	Inadequate mentions of the past research (state of the art) from the same area of study.
4. Materials and Methods	- Insufficient landsat imagery validation method for land use data.
5. Results	
6. Discussion and conclusion	Need more elaborated explanation of the Soppeng suitability for agrotourism area based on the administrative landscape.
7. References and citations	There are some outdated reference.
8. Others	

HASIL REVISI 3

Drs. H. Sukri Nyompa, SH, M.Si., Ph.D. UNM <sukrinyompa@unm.ac.id>   29 November 2022 pukul 15.25
Kepada: environmentAsia Journal <environmentasiajournal.submit@gmail.com>, environmentasiajournal@gmail.com

Dear Editor,

We have finished revising our paper. Please find the attached file.
We are looking forward to hearing from you soon.

Best regards,

Sukri Nyompa
[Kutipan teks disembunyikan]

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Reviewer 1				
No.	Section	Reviewer comments	Responses	Page in Journal
1	Introduction	The introduction in general is good, but in this section, it is necessary to add the condition of agro-tourism in Soppeng Regency. The conditions in question can be in the form of what plants are being cultivated, the number of visitors, or others so that they can be linked to the results of the research.	Meanwhile, in Soppeng regency, there was a study about agrotourism to study and analyze the potential and attractiveness of nature tourism in the Bulu Dua area and formulated a community-based nature tourism management strategy in the Bulu Dua area, Soppeng Regency (Muhammad & Darmawan, 2019).	Page 1
2	Materials and Methods	The actual number of parameters can still be added again. But with 3 parameters is good enough.	In tourism areas, planning is a systematic tool used to determine the initial moment of a situation and the best way to achieve it. Regional planning is carried out through several approaches, one of which is the natural resource approach, namely character determination and alternative recreation and tourism activities based on monitoring the conditions and condition of the resources. In assessing physical conditions, land use, slope, and soil type can be important indicators in accordance with the recommendations of several experts and existing regulations.	Page 3
3	Results	The research results are quite good. In this section, it is necessary to have 1 or 2 photos from the location that present the physical conditions at the research location so that readers will know more about the conditions in the field.	Figure 6. Some objects in Soppeng that can be developed into agrotourism	Page 9
4	Discussion and conclusion	In the results and discussion section, it is necessary to mention what the limiting	The results of the identification of the area's suitability found that the soil types scattered in	

| | | factors were found in each land suitability class. Then it can also be added how the spatial distribution of each land suitability class has been found and associated with the 3 indicators used. | Soppeng Regency are quite good for use as an agrotourism area because this area has good fertility and humidity levels, especially in lowland areas. The relationship between soil type and agrotourism is closely related, where soil type is the main factor of soil fertility whose function is vital for plant growth, but highland areas will usually affect soil fertility due to different agricultural management practices, regardless of soil type. In addition to slopes, soil types, and land use, hydrological factors also influence soil and plant moisture as the basic things that support human life and development (Zhou & Wang, 2019). These factors will certainly greatly affect the productivity level of the agro-tourism area because the location of Soppeng Regency is also located along the watershed so that it has the potential to irrigate the soil and crops around it. | |
| 5 | Others | In the Acknowledgment section, there are still blank sections. Please complete. | This research is fully funded by Makassar State University with contract number: SP DIPA-023.17.2.677523/2021. | Page 11 |

Reviewer 2				
No.	Section	Reviewer comments	Responses	Page in Journal
	Introduction	Inadequate mentions of the past research (state of the art) from the same area of the study	Some of the objects in Soppeng that can be identified as an agricultural site such as rice fields, corn plantation, cocoa plantation, mango plantation, cashew plantation, dragon fruit plantation, watermelon plantation, peanut plantation, livestock farms, and cocoa seedling sites.	Page 2

	Materials and Method	Insufficient landsat imagery validation method for land use data	Moreover, the land use data derived from Landsat needs to be validated through a confusion matrix. Based on the ground check and the matrix analysis, the error percentage is 15%. Hence, the land use data can be used for further analysis.	Page 2
	Discussion and Conclusion	Need more elaborated explanation of the Soppeng suitability for agrotourism area based on the administrative landscape	Land suitability for agro-tourism planning in Soppeng Regency resulted in 5 suitability classifications. A very suitable area stretches from the north, which borders Sidenreng Rappang Regency, towards the northeast, which borders Wajo Regency; to the east, which borders Bone Regency. Meanwhile, the appropriate area is located in the mid-administrative area of Soppeng Regency, and a small part of the suitability area borders Wajo Regency and Bone Regency. While the area is quite suitable, it is also in the middle of the administration of Soppeng Regency and is bordered by Bone Regency in the south. On the other hand, the unsuitable area for agro-tourism stretches from the northwest of Soppeng Regency which borders Sidenreng Rappang Regency to parts of Barru Regency and Bone Regency, while the area that is not very suitable for agrotourism is found in a fairly steep mountainous area in the southwest of Soppeng Regency. which also borders Barru Regency.	Page 10
	References and citations	There are some outdated reference	Muhammad, A., & Darmawan, M. (2019). Pengembangan Potensi Agroekowisata Di Kawasan Bulu Dua Kabupaten Soppeng. Journal of Forestry Research, 2(2), 105–119. https://doi.org/10.32662/gjfr.v2i2.718.	Page 12

1. Introduction

The development of the tourism industry without paying attention to environmental impacts will certainly harm humans themselves. Therefore, environmental development must be developed not to damage the environment and provide knowledge to the wider community (Díez-Gutiérrez & Babri, 2020). The greater public knowledge about the environment, the better the impact will be felt (Gautam, 2020). This is because tourism can be a threat in the form of conservation area expansion that can damage protected ecosystems and disrupt tourism's potential sustainability (Canteiro et al., 2018).

Indonesia's diversity of tourism potential includes natural resource-based tourism, including rural and agricultural landscapes where tourism has its charm as a destination that can provoke an increase and turn the wheels of the economy, especially for the government and society (Situmorang et al., 2019). Rural tourism has now developed following the times where the main focus is locations that are the main icons of natural scenery, agricultural land, and culture (Xiang et al., 2020). In simple terms, agrotourism is a tourism activity that utilizes the capabilities of agricultural land, processing production processes, and distributing production products in which there are activities to introduce the rural culture and preserve the environment (Kaswanto, 2015).

Various previous studies raised almost the same theme, namely agrotourism – traditional knowledge and rural biotechnology (Ciolac et al., 2015) and Agrotourism as prospects, interests, goals, and challenges in Nepal (Khanal & Shrestha, 2019). Meanwhile, in Soppeng regency, there was a study about agrotourism to study and to analyze the potential and attractiveness of nature tourism in the Bulu Dua area and formulated a community-based nature tourism management strategy in the Bulu Dua area, Soppeng Regency (Muhammad & Darmawan, 2019). Therefore, in this research, the researchers intend to present information about the use of geographic information systems (GIS) to identify the suitability of agrotourism in Soppeng Regency, which is viewed from the physical aspect of the environment using the Overlay analysis technique (overlapping parameter maps) with the scoring and weighting method using the application. Arcgis 10.8

Diez-Gutierrez and Babri (2020) studied the development of tourism that can harm the environment. One of the factors causing increased pollution around tourist attractions comes from tourist behavior. One way to provide information to tourists is by determining the right tourist route. This study concludes that policymakers should consider improving the transportation system.

Canteiro et al (2018) revealed that the threat of environmental expansion would impact the tourism sector. This study uses the Tourism Impact Assessment (TIA) method by evaluating the environmental impacts associated with nature conservation areas. The result is that fifteen tourism activities affect four biological components (biodiversity, land cover, soil, and water).

Xiang et al. (2020) stated that rural eco-tourism focuses on development by utilizing natural resources. Determination of standards using survey and evaluation methods in determining rural eco-tourism. This study uses the Decision Alternative Ratio Evaluation System (DARE) and the Delphi method. The research results in this scientific research show that natural conditions and the human condition are the core elements of rural eco-tourism resources.

Kaswanto (2015) studied the evaluation of agro-tourism based on four aspects: agriculture, tourism, beauty, and amenities (ATBA). That is, the development of natural tourism focuses on agriculture that is right for tourism. Spatial distribution of land use using Landsat image. Spatial distribution of land use using Landsat imagery. The spatial approach is used by combining the element values of each landscape. This study aims to design a land management scenario for agro-

tourism using the ATBA method. At the same time, Chen (2020) discusses the environmental impacts caused by changes in environmental ecosystems. The method used to determine environmental changes using (ESV) is to assess each ecosystem.

Exploring the potential of agrotourism in Soppeng Regency, South Sulawesi province, Indonesia has been explained the intensity of spatial use aimed at planning and developing agrotourism areas and integrating tourism activities to support the preservation of technically irrigated agricultural land (Soppeng Regency Government, 2012). Some of the objects in Soppeng that can be identified as an agricultural site such as rice fields, corn plantation, cocoa plantation, mango plantation, cashew plantation, dragon fruit plantation, watermelon plantation, peanut plantation, livestock farms, and cocoa seedling sites. This has become one of the drivers of research on agrotourism development in the Soppeng Regency. Thus, the potential for agricultural tourism, nature conservation, and culture can be maintained to preserve nature and culture as a gift from God Almighty. It is an effort to promote general welfare for the community through the development of village tourism potential by utilizing the potential of the environment and land for the benefit of tourist attractions for the welfare of the local community (Soppeng Regency Government, 2019).

2. Materials and Method

The type of research used in this research is descriptive quantitative research. Quantitative descriptive research is a research method based on the philosophy of positivism or a perspective when understanding a fact-based on empirical data, where data analysis is more statistical (Creswell & Creswell, 2017). Quantitative descriptive research is also a conscious and systematic effort to provide answers to a problem and or obtain more in-depth and broad-based information on an incident phenomenon using the stages of a quantitative approach. Moreover, the land use data that derived from Landsat, it needs to be validated through a confusion matrix. Based on the ground check and the matrix analysis, the error percentage is 15%. Hence, the land use data can be used for further analysis.

Table 1. Types and sources of research data

No	Data	Data Type	Data Source
1	Administration Map	Primary Data	Related Agencies
2	Slope	Secondary Data	Observation and Dem Srtm
3	Type Of Soil	Secondary Data	Related Agencies
4	Land Use	Primary Data	Landsat 8 Image Of 2019

2.1. Research sites

Soppeng Regency is located in South Sulawesi Province. It is divided into 8 sub-districts: Marioriwawo District, Lalabata District, Liliriaja District, Ganra District, Citta District, Lilirilau Donri-Donri District, and Marioriawa District. Marioriawa District is the largest sub-district, with an area of 320 km2 or about 21.3% of the total area of Soppeng Regency. Meanwhile, the Citta sub-district is the sub-district with the smallest area, which is only 40 km2 or 2.7 percent of the total area of

Soppeng Regency. Soppeng Regency is geographically located at coordinates 4 6'00" - 4 32'00" South Latitude and 119 47'18" - 120 06'13" East Longitude, as shown in Fig 1 below.
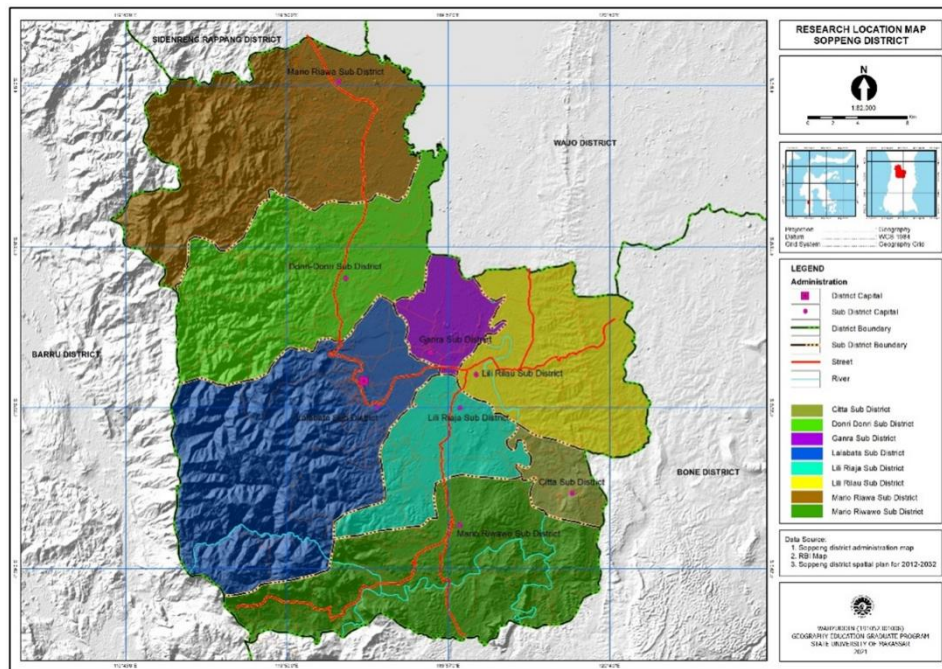

Figure 1. Research location map

Soppeng Regency boundaries include:
a. North side: Sidenreng Rappang Regency
b. East: Wajo Regency and Bone Regency
c. Southside: Bone Regency
d. West: Barru Regency

Soppeng Regency is surrounded by a vast mountainous landscape and a topography that varies from flat to steep, with natural characteristics typical of the countryside. The research location has various agricultural and plantation resources and natural and artificial landscapes with high enough potential to be used as agro-tourism objects.

2.2. Agrotourism Land Suitability Zone Analysis

In the context of tourism areas, planning is a systematic tool used to determine the initial moment of a situation and the best way to achieve it. Regional planning is carried out through several approaches, one of which is the natural resource approach, namely character determination and alternative recreation and tourism activities based on the results of monitoring the conditions and condition of the resources. In assessing physical conditions, land use, slope, and soil type can be important indicators in accordance with the recommendations of several experts and existing regulations.

Spatial analysis uses ArcGIS 10.8 software and overlay technique or parameter stacking after determining each criterion and scoring (Table 2 and Table 3). The spatial method is based on the slope, land use, and erosion sensitivity according to soil type.

Table 2. Assessment criteria and a recreational room suitability score

Aspects	Standards of Conformity	Criteria	Score
Land Use	There is no building structure and other vegetation other than the ground cover. The site is dominated by open land use.	fits	3
	The site is still quite dominated by open land use, but there are several structures and buildings and vegetation other than the ground cover.	Sufficiently Suitable	2
	Dominant site with Incompatible building	not suitable	1
Slope	0-8 % (Flat and Sloping)	Appropriate	3
	8-15 % (Slightly Steep)	Fairly Appropriate	2
	>15 % (Steep and Steep)	not suitable	1

*good=3, moderate=2, bad= 1, Source: (Hardjowigeno, 2007)

Table 3. Assessment criteria and conformity score sensitivity to erosion

Aspects	Standards of Conformity	Criteria	Score
Soil Type	Alluvial, Glei Planosol Hydromorphic Gray Soil, Literita Groundwater, Suitable Latosol	Suitable Latosol (Not Erosion Sensitive)	3
	Brown Forest Soil, Non Calcis Brown, Mediteran, Andosol, Laterit, grumosol, podsol, podsolik	Sufficiently (Sensitive erosion)	2
	Regosol, Litosol, organosol, renzina	Incompatible (Sensitive erosion)	1

*good=3, moderate=2, bad=1, Source: (Ministry of Agriculture, 1980)

Based on the assessment criteria and the score for the suitability of the recreation space above, a land suitability map for the designation of agrotourism areas in Soppeng was compiled. The determination of the classification level is as follows:

The criteria for the suitability class were obtained from the calculation of the scores for each parameter. The results of the assessment of tourist areas are clarified as A (Appropriate), SA (Sufficiently Appropriate), and NA (Not Appropriate)

3. Results and Discussion

3.1. Analysis of the level of suitability of recreation space based on the slope of the slope

Slope data obtained from DEM SRTM 30 meters resolution. The results showed that the area that is suitable to be used as an agrotourism area has an area of 84.429,42 Ha (61,91%), while the area that is not suitable has an area of 13.099,35 Ha (9,61%) of the total area of Soppeng Regency. The results of the analysis can be seen in Table 4. The distribution can be seen in Fig 2, which generally shows the appropriate criteria.

Table 4. Level of suitability based on slope

No	Classification	Slope (%)	Large

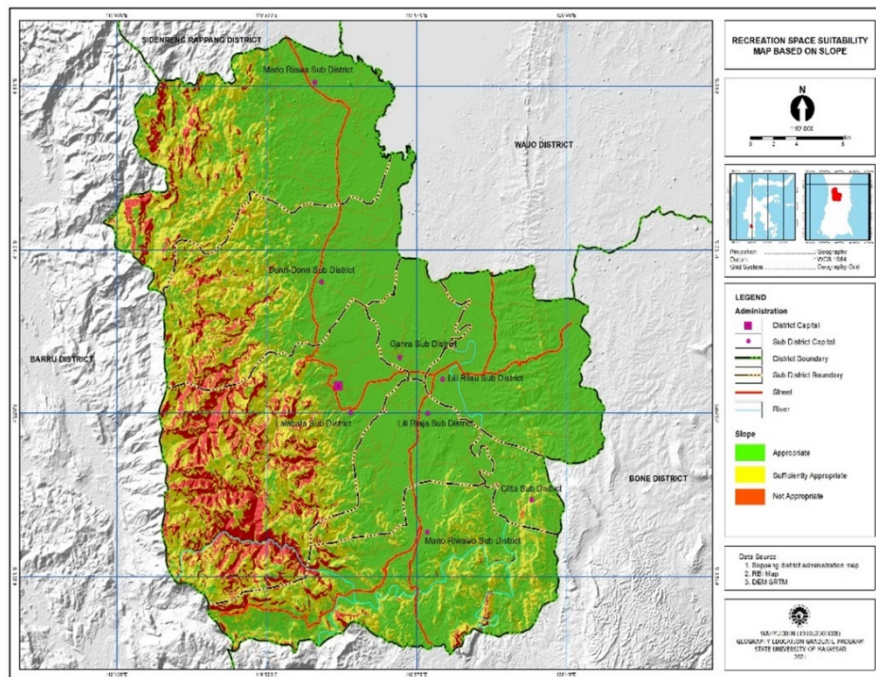|			(Ha)	(%)
1	Appropriate	0-8	84.429,42	61,91
2	Sufficiently Appropriate	> 8-15	38.838,08	28,48
3	Not Appropriate	> 15	13.099,35	9,61
	Total		136.366	100

Source: Analysis results, 2021

Figure 2. Suitability map of recreation space based on slope

3.2.   Analysis of the level of suitability of recreation space based on soil type

Determination of recreation space based on soil type is used as one of the main parameters. Where the results of the analysis show that the classification is quite suitable, having the largest area, which is 106,639.46 Ha (78.2%) and the unsuitable classification has the smallest area of 1,415.2 (1.03%). More details can be seen in Table 5 and its spatial distribution in Fig. 3, where a fairly adequate classification dominates the level of suitability of the recreation space according to the gromusol and Mediterranean soil.

Table 5. Level of suitability by soil type

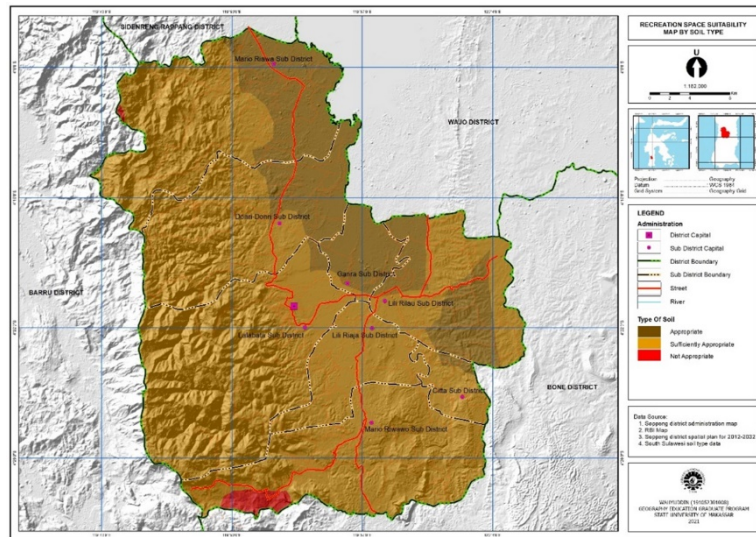| No	Classification	Type of Soil	Large	
			(Ha)	(%)
1	Appropriate	Aluvial	28.311,79	20,76
2	Sufficiently Appropriate	Gromusol	17.180,64	12,60
3		Mediteran	89.458,82	65,60
4	Not Appropriate	Regosol	88,10	0,06
5		Litosol	1.327,10	0,97
	Total		136.366	100

Source: Analysis results, 2021

Figure 3. *Recreation space suitability map by soil type*

3.3. Analysis of the level of suitability of recreation space based on land use

Image interpretation was carried out using Landsat 8 image data in 2019. Where the results of the analysis of the suitability of recreation space based on land use, the classification was obtained according to the largest area of 96,958.93 Ha (71.1%), and the criteria did not match the smallest area of 4,877.7 Ha (3,6%). More details can be seen in Table 6 and its spatial distribution in Fig 4. The level of suitability of recreational spaces is generally dominated by appropriate classification so that, in essence, Soppeng Regency has the potential to become a sustainable agro-tourism area.

Table 6. *Level of suitability by land use*

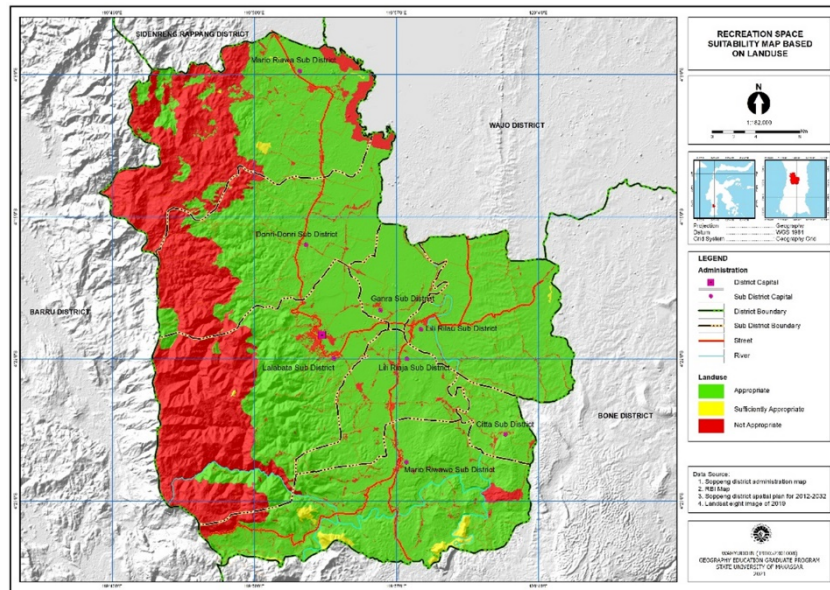| No	Classification	Landuse	Large	
			(Ha)	**(%)**
1	Appropriate	Field	10.001,97	7,33
2		garden	17.409,58	12,77
3		ricefield	28.564,92	20,95
4		Mixed garden	40.982,46	30,05
5	Sufficiently Appropriate	bushes and shrubs	1.280,54	0,94
6		forest	33.219,63	24,36
7	Not Appropriate	Body of water	1.430,45	1,05
8		settlement	3.477,25	2,55
	Total		136.366	100

Source: Analysis results, 2021

Figure 4. Recreation space suitability map by land use

3.4. Analysis of Land Suitability for Agrotourism Areas

Based on the results of the overlay analysis using the Arcgis 10.8 application using the three indicators above, the suitability of agrotourism land were obtained, divided into three suitability zones, namely appropriate, quite suitable, and not suitable. The area suitable for agrotourism has the widest distribution, 72.794.28 Ha (53.52%), and the unsuitable classification has the smallest area of 28.269.02 Ha (20.87%). The results of the overlay analysis can be seen in Table 7.

Table 7. The wide distribution of overlayed agro-tourism areas

No	Classification	Large	
		(Ha)	(%)
1	Appropriate	72.983.02	53,52
2	Sufficiently Appropriate	34.918.65	25,61
3	Not Appropriate	28.464.33	20,87
	Total	136.366	100

Source: Analysis results, 2021

The identification of the spatial distribution of land suitability for agrotourism in the Soppeng Regency can be seen in Fig 5. Generally, the Soppeng Regency area is dominated by area criteria suitable for agrotourism. Based on the results of the analysis and field observations, it is shown that the existing conditions in Soppeng Regency are suitable as an agro-tourism planning area. The abundant agro-tourism potential of Soppeng Regency has received attention from the district government, as evidenced by the existence of the Soppeng Regency Regional Regulation (Soppeng Regency Government, 2012).
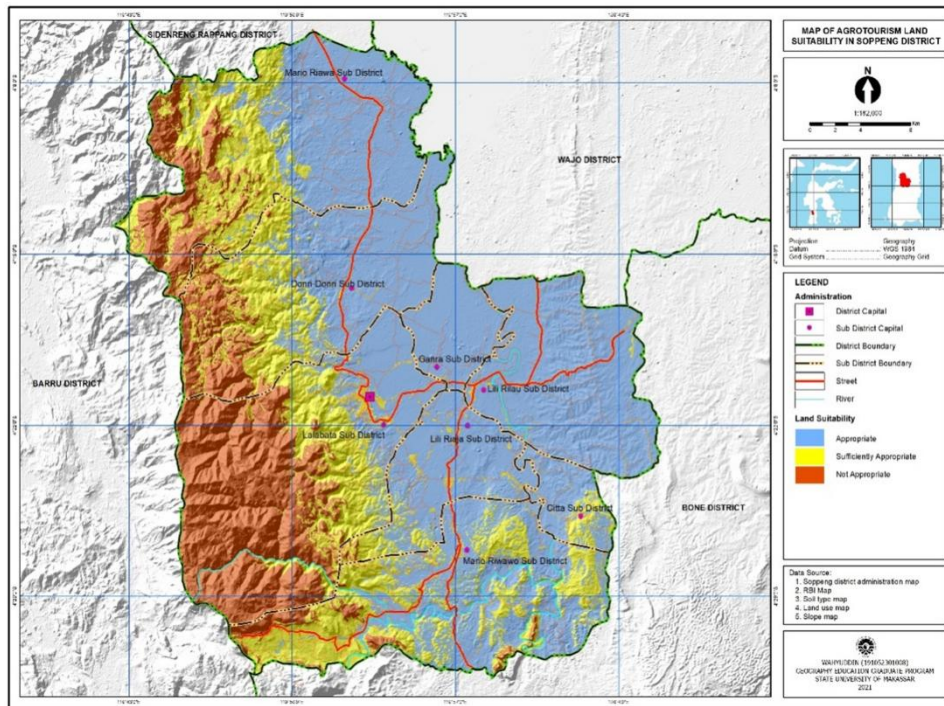
Figure 5. *Agro-tourism land suitability map in Soppeng district*

Identification of land suitability for agro-tourism is carried out to find out whether each area in Soppeng Regency has the potential for agrotourism development and to find out the various problems that exist. This is very important to study because, in general, the land contained in the agrotourism area includes natural resources that have a lot of potential and benefits to accommodate the socio-economic activities of the community in maximizing the environment. The current rural environment is more likely to develop towards educational tourism. This is good so that the general public can know about the life and activities of farmers and create a positive image of agriculture for the next generation (Petroman et al., 2016). Thus, the results of this education can add to the public's knowledge about marketing strategies for agricultural products, of course, with the government and the community (Liang et al., 2020).

The results of the suitability for agrotourism areas based on the slope show beautiful views, especially towards the hills, which provide more visual value to attract visitors' attention. The area of Soppeng Regency, especially in sloping to steep areas and close to resident villages, has a great opportunity to develop development and cultivation activities related to agrotourism (Gunarto, 2017). At the same time, the steep area is very important to pay attention to because this area is very prone to erosion to landslides which can endanger site users because currently, there have been many minor damages due to soil erosion caused by land degradation (Huang et al., 2016). Therefore, planting plants in mountainous areas with steep slopes will provide stability to the slopes that can withstand soil movement if erosion occurs (Grima et al., 2020).
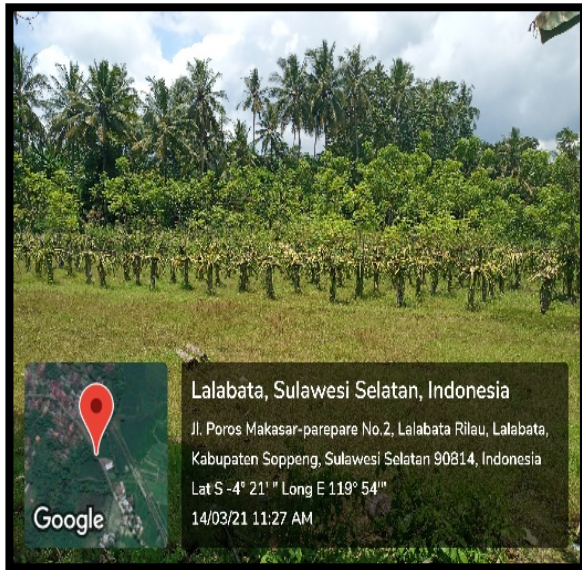
Figure 6. *Some objects in Soppeng that can be developed into agrotourism*

Objects that have the highest value are the location of rice fields, peanut plantations, and farms. The three object locations are located in areas suitable for agro-tourism planning. The location of the object has the condition of agro-agricultural tourism attractions, and the accessibility to the location is fairly easy and is located around the main road. The object in the agro-tourism planning area that has the lowest value is the cashew plantation. Various agricultural activities are minimal, and there are only cashew plantations associated with residential areas, so it is very difficult to enjoy the natural scenery of the cashew plantations. Meanwhile, the accessibility to the location is very easy, and the road conditions are smooth and paved.

Most of the objects from plantations, agriculture to livestock that have agro-tourism potential in Soppeng Regency have been equipped with various natural scenery and supporting accessibility, but in terms of the availability of tourism resources, there is still a need for improvement and performance from various parties for the convenience of visitors who travel. If these four factors have been met, the objects in the agro-tourism planning area will be formed and become one of the recommended tourist sites.

The determination of agrotourism areas is not only based on the slope. But also in terms of soil type. The results of the identification of the area's suitability found that the soil types scattered in Soppeng Regency are quite good for use as an agrotourism area because this area has good fertility and humidity levels, especially in lowland areas. The relationship between soil type and agrotourism is closely related, where soil type is the main factor of soil fertility whose function is vital for plant growth, but highland areas will usually affect soil fertility due to different agricultural management practices, regardless of soil type (Tran et al., 2021).

The results of Landsat 8 image analysis in 2019 Soppeng Regency has agro-tourism potential seen from land use. In general, it consists of forests, mixed gardens, fields, plantations, settlements, rice fields, shrubs, and bodies of water. This land's potential is likely to become an agrotourism attraction even though it has not been fully utilized optimally. Therefore, it is necessary to assess the suitability of appropriate land use and implement policies by the government and involve every stakeholder in order to be able to reach the right decision-making for the sustainability of agricultural tourism (Lazoglou & Angelides, 2020).

Although land use has a great opportunity as a determinant aspect of agrotourism, if its management is not regulated in such a way, it will not get maximum results. For this reason, this research can be used as a reference so that land use in Soppeng Regency can be more focused so that land use management can be cultivated and carried out optimally in order to preserve the environment, of course, with the cooperation of the community and the government as the core of environmental management (Musavengane, 2019).

In addition to slopes, soil types, and land use, hydrological factors also influence soil and plant moisture as the basic things that support human life and development (Zhou & Wang, 2019). These factors will greatly affect the agro-tourism area's productivity level because the Soppeng Regency location is also along the watershed, so it has the potential to irrigate the soil and crops around it (Soppeng Regency Government, 2017).

Land suitability for agro-tourism planning in Soppeng Regency resulted in 5 suitability classifications. A very suitable area stretches from the north, which borders Sidenreng Rappang Regency, towards the northeast, which borders Wajo Regency to the east, which borders Bone Regency. Meanwhile, the appropriate area is located in the mid-administrative area of Soppeng Regency, and a small part of the suitability area borders Wajo Regency and Bone Regency. While the area is quite suitable, it is also in the middle of the administration of Soppeng Regency and is bordered by Bone Regency in the south. On the other hand, the unsuitable area for agro-tourism stretches from the northwest of Soppeng Regency, which borders Sidenreng Rappang Regency, to parts of Barru Regency and Bone Regency, while the area that is not very suitable for agrotourism is found in a fairly steep mountainous area in the southwest of Soppeng Regency, which also borders Barru Regency.

In general, Soppeng Regency has the potential for agro-tourism development based on the analysis results using the Overlay technique that combines each of the parameters used, namely soil type, land use, etc, and slope. Furthermore, a land suitability map was made for agrotourism areas in Soppeng Regency. The overlay results produce a composite map and divide the area into three land suitability areas: suitable, moderately suitable, and inappropriate. So in essence, Soppeng Regency is suitable for agro-tourism development.

The analysis results can be used as an agrotourism development plan per the village's current conditions and development. Rural tourism can contribute to the development of agro-tourism that is tailored to the objectives of sustainable regional development and contributes to cultural, economic, and social development (Kastenholz et al., 2018).

Theoretically, the development of agrotourism certainly requires tourist attractions, both natural and artificial. For the development of agrotourism in Soppeng Regency, tourist attractions already exist, consisting of agricultural land, and natural scenery accompanied by biodiversity. The diversity of flora and fauna has the economic potential to be marketed as a promising agro-tourism attraction (Navarro-Martínez et al., 2020). However, these tourism potentials require maintenance that pays attention to sustainable and culturally valuable ecosystems (Chen, 2020).

Efforts to develop agrotourism in Soppeng Regency take several policies which will later be used as a guide in implementing agrotourism. The designation of agrotourism areas has been determined, which are located in Mariolau Village and Gattareng Village in Marioriwawo District (Soppeng Regency Government, 2012). Based on the physical analysis of the land in this study, the location is in reasonably good criteria because it needs several conditions in developing agrotourism areas because it is located in a varied topography. However, these limiting factors can be addressed by planting conservation plants that can prevent landslides and managing agricultural land that pays attention to environmental aspects. This limiting factor also requires cooperation from various

parties so that in the future, there will be no overlapping interests that can damage the development of agrotourism areas in Soppeng Regency.

4. Conclusion

Soppeng Regency, South Sulawesi province, Indonesia, has a natural beauty in the form of a mountainous area and many agricultural crop commodities, which are quite abundant, making this area have agrotourism potentials that are feasible to be developed. The data analysis results using the overlay technique show that suitable criteria for agrotourism areas dominate Soppeng Regency in general. However, in identifying the suitability of agro-tourism in this research, it is still not perfect due to the limitations of the data analysis used. Therefore, for similar research in the future, it is hoped that it will be able to identify the suitability of agrotourism viewed from various factors (physical, biophysical, social, and economic) and, most importantly, reach the stage of planning the agrotourism landscape.

Acknowledgment

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The Utilization of Geographic Information Systems (GIS) for the Suitability of Agro-tourism Land

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Abstract

Development of environmentally friendly tourism can be interpreted as development that does not damage the environment and uses land wisely. In terms, agrotourism is a tourism activity that explore and utilize the potential of the environment in it as a tourist attraction. This study aims to determine the agrotourism area by the physical conditions of the environment in Soppeng Regency, South Sulawesi, Indonesia. Determining the suitability of agrotourism areas using quantitative descriptive methods using overlay analysis techniques or stacking parameter maps (land use, soil type, and slope) that have been scored and weighted beforehand using the Arcgis 10.8 application. The results of the overlay produce a composite map and divide the area into three classifications, namely areas that are suitable, quite suitable, and not suitable. The suitable area is 72,794 Ha (53.52%), the suitable area is 34,726.96 Ha (25.61%) and the unsuitable area is 28,269.02 Ha (20.87%). Based on the results of the analysis of several parameters above, it shows that Soppeng Regency has the potential to be used as an agrotourism area which is also supported by the various types of agricultural activities in Soppeng Regency.

Keywords: Land Suitability; Geographic Information System (GIS); Land Suitability; Agrotourism

1. Introduction

The development of the tourism industry without paying attention to environmental impacts will certainly harm humans themselves. Therefore, environmental development needs to be developed not to damage the environment and provide knowledge to the wider community (Díez-Gutiérrez & Babri, 2020). The greater public knowledge about the environment, the better the impact will be felt (Gautam, 2020). This is because tourism can be a threat in the form of conservation area expansion that can damage protected ecosystems to disrupt the sustainability of tourism potentials (Canteiro et al., 2018).

Indonesia's diversity of tourism potential includes natural resource-based tourism, including rural and agricultural landscapes where tourism has its charm as a destination that can provoke an increase and turn the wheels of the economy, especially for the government and society (Situmorang et al., 2019). Rural tourism has now developed following the times where the main focus is locations that are the main icons of natural scenery, agricultural land, and culture (Xiang et al., 2020). In simple terms, agrotourism is a tourism activity that utilizes the capabilities of agricultural land, processing production processes, and distributing production products in which there are activities to introduce the rural culture and preserve the environment (Kaswanto, 2015).

Various previous studies raised almost the same theme, namely agrotourism – traditional knowledge and rural biotechnology (Ciolac et al., 2015) and Agrotourism as prospects, interests,

goals, and challenges in Nepal (Khanal & Shrestha, 2019). Meanwhile, in Soppeng regency, there was a study about the agrotourism to study and to analyze the potential and attractiveness of natural tourism in the Bulu Dua area and formulated a community-based nature tourism management strategy in the Bulu Dua area, Soppeng Regency (Muhammad & Darmawan, 2019). Therefore, in this research, the researchers intend to present information about the use of geographic information systems (GIS) to identify the suitability of agrotourism in Soppeng Regency, which is viewed from the physical aspect of the environment using the Overlay analysis technique (overlapping parameter maps) with the scoring and weighting method using the application. Arcgis 10.8

Diez-Gutierrez and Babri (2020) studied the development of tourism that can harm the environment. One of the factors causing increased pollution around tourist attractions comes from tourist behavior. One way to provide information to tourists is by determining the right tourist route. This study concludes that policymakers should consider improving the transportation system.

Canteiro *et al* (Canteiro et al., 2018) revealed that the threat of environmental expansion would impact the tourism sector. This study uses the Tourism Impact Assessment (TIA) method by evaluating the environmental impacts associated with nature conservation areas. The result is that fifteen tourism activities affect four biological components (biodiversity, land cover, soil, and water).

Xiang *et al* (2020) stated that rural eco-tourism focuses on development by utilizing natural resources. Determination of standards using survey and evaluation methods in determining rural eco-tourism. This study uses the Decision Alternative Ratio Evaluation System (DARE) and the Delphi method. The research results in this scientific research show that natural conditions and the human condition are the core elements of rural eco-tourism resources.

Kaswanto (2015) studied the evaluation of agro-tourism based on four aspects, namely agriculture, tourism, beauty, and amenities (ATBA). That is, the development of natural tourism focuses on agriculture that is right for tourism. Spatial distribution of land use using Landsat image. Spatial distribution of land use using Landsat imagery. The spatial approach is used by combining the element values of each landscape. This study aims to design a land management scenario for agro-tourism using the ATBA method. At the same time, Chen (2020) discusses the environmental impacts caused by changes in environmental ecosystems. The method used to determine environmental changes using (ESV) is to assess each ecosystem.

Exploring the potential of agrotourism in Soppeng Regency, South Sulawesi province, Indonesia has been explained about the intensity of spatial use aimed at planning and developing agrotourism areas and integrating tourism activities to support the preservation of technically irrigated agricultural land (Soppeng Regency Government, 2012). Some of the objects in Soppeng that can be identified as an agricultural site such as rice fields, corn plantation, cocoa plantation, mango plantation, cashew plantation, dragon fruit plantation, watermelon plantation, peanut plantation, livestock farms, and cocoa seedling sites. This has become one of the drivers of research on agrotourism development in the Soppeng Regency. Thus, the potential for agricultural tourism, nature conservation, and culture can be maintained to preserve nature and culture as a gift from God Almighty. It is an effort to promote general welfare for the community through the development of village tourism potential by utilizing the potential of the environment and land for the benefit of tourist attractions for the welfare of the local community (Soppeng Regency Government, 2019).

2. Materials and Method

The type of research used in this research is descriptive quantitative research. Quantitative descriptive research is a research method based on the philosophy of positivism or a perspective when understanding a fact-based on empirical data, where data analysis is more statistical (Creswell & Creswell, 2017). Quantitative descriptive research is also a conscious and systematic effort to provide answers to a problem and or obtain more in-depth and broad-based information on an incident phenomenon using the stages of a quantitative approach. Moreover, the land use data that

derived from Landsat, it needs to be validated through confusion matrix. Based on the ground check and the matrix analysis, the error percentage is 15%. Hence, the land use data can be used for further analysis.

Table 1. Types and sources of research data

No	Data	Data Type	Data Source
1	Administration Map	Primary Data	Related Agencies
2	Slope	Secondary Data	Observation and Dem Srtm
3	Type Of Soil	Secondary Data	Related Agencies
4	Land Use	Primary Data	Landsat 8 Image Of 2019

2.1. Research sites

Soppeng Regency is located in South Sulawesi Province. It is divided into 8 sub-districts: Marioriwawo District, Lalabata District, Liliriaja District, Ganra District, Citta District, Lilirilau Donri-Donri District, and Marioriawa District. Marioriawa District is the largest sub-district, with an area of 320 km2 or about 21.3% of the total area of Soppeng Regency. Meanwhile, the Citta sub-district is the sub-district with the smallest area, which is only 40 km2 or 2.7 percent of the total area of Soppeng Regency. Soppeng Regency is geographically located at coordinates 4 6'00" - 4 32'00" South Latitude and 119° 47'18" - 120 06'13" East Longitude as shown in Fig 1 below.

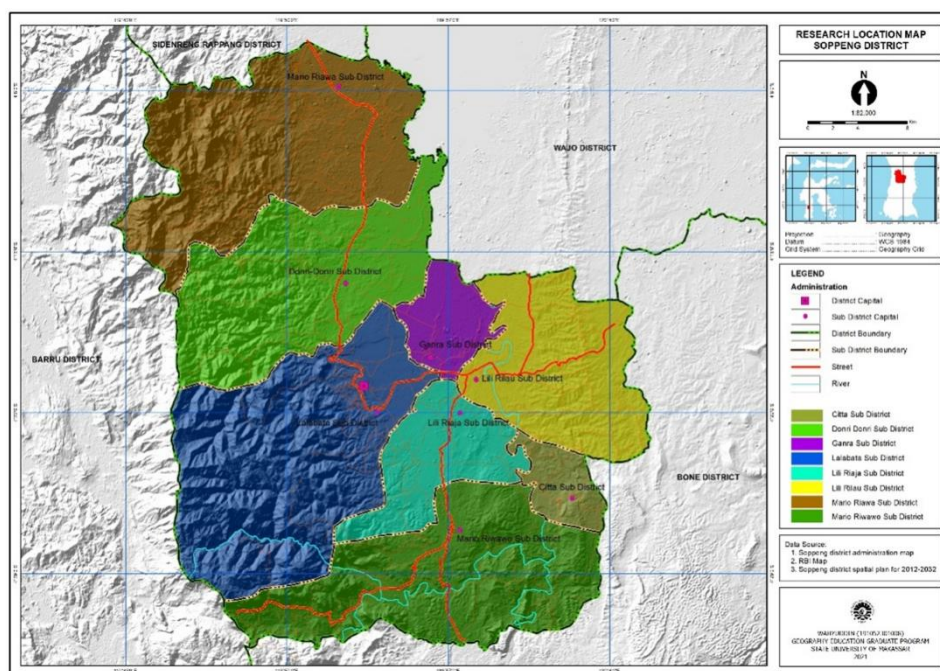**Figure 1**. Research location map

Soppeng Regency boundaries include:
a. North side: Sidenreng Rappang Regency
b. East: Wajo Regency and Bone Regency
c. Southside: Bone Regency
d. West: Barru Regency

Soppeng Regency is surrounded by a vast mountainous landscape and a topography that varies from flat to steep with natural characteristics typical of the countryside. The research location has

various agricultural and plantation resources and natural and artificial landscapes that have high enough potential to be used as agro-tourism objects.

2.2. Agrotourism Land Suitability Zone Analysis

In the context of tourism areas, planning is a systematic tool used to determine the initial moment of a situation and the best way to achieve it. Regional planning is carried out through several approaches, one of which is the natural resource approach, namely character determination and alternative recreation and tourism activities based on the results of monitoring the conditions and condition of the resources. In assessing physical conditions, land use, slope, and soil type can be important indicators in accordance with the recommendations of several experts and existing regulations.

Spatial analysis uses ArcGIS 10.8 software and overlay technique or parameter stacking after determining each criterion and scoring (Table 2 and Table 3). The spatial method is based on the slope, land use, and erosion sensitivity according to soil type.

Table 2. Assessment criteria and a recreational room suitability score

Aspects	Standards of Conformity	Criteria	Score
Land Use	There is no building structure and other vegetation other than the ground cover. The site is dominated by open land use.	fits	3
	The site is still quite dominated by open land use, but there are several structures and buildings and vegetation other than the ground cover.	Sufficiently Suitable	2
	Dominant site with Incompatible building	not suitable	1
Slope	0-8 % (Flat and Sloping)	Appropriate	3
	8-15 % (Slightly Steep)	Fairly Appropriate	2
	>15 % (Steep and Steep)	not suitable	1

*good=3, moderate=2, bad= 1, Source: (Hardjowigeno, 2007)

Table 3. Assessment criteria and conformity score sensitivity to erosion

Aspects	Standards of Conformity	Criteria	Score
Soil Type	Alluvial, Glei Planosol Hydromorphic Gray Soil, Literita Groundwater, Suitable Latosol	Suitable Latosol (Not Erosion Sensitive)	3
	Brown Forest Soil, Non Calcis Brown, Mediteran, Andosol, Laterit, grumosol, podsol, podsolik	Sufficiently (Sensitive erosion)	2
	Regosol, Litosol, organosol, renzina	Incompatible (Sensitive erosion)	1

*good=3, moderate=2, bad=1, Source: (Ministry of Agriculture, 1980)

Based on the assessment criteria and the score for the suitability of the recreation space above, a land suitability map for the designation of agrotourism areas in Soppeng was compiled. The determination of the classification level is as follows:

From the calculation of the scores for each parameter, the criteria for the suitability class were obtained. The results of the assessment of tourist areas are clarified as A (Appropriate), SA (Sufficiently Appropriate), and NA (Not Appropriate)

3. Results and Discussion

3.1. *Analysis of the level of suitability of recreation space based on the slope of the slope*

Slope data obtained from DEM SRTM 30 meters resolution. The results showed that the area that is suitable to be used as an agrotourism area has an area of 84.429,42 Ha (61,91%), while the area that is not suitable has an area of 13.099,35 Ha (9,61%) of the total area of Soppeng Regency. The results of the analysis can be seen in Table 4. The distribution can be seen in Fig 2, which generally shows the appropriate criteria.

Table 4. Level of suitability based on slope

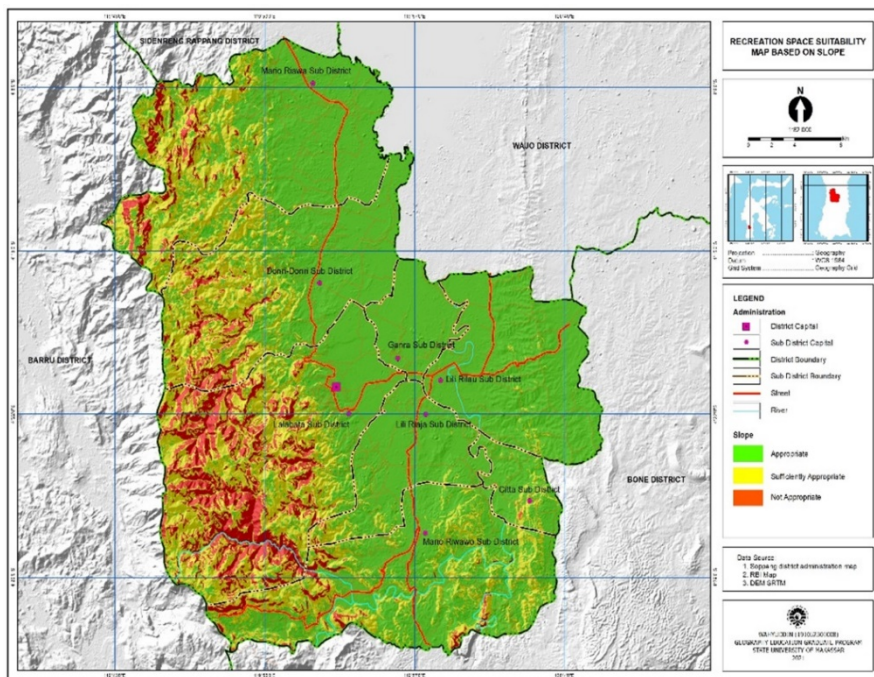| No	Classification	Slope (%)	Large	
			(Ha)	(%)
1	Appropriate	0-8	84.429,42	61,91
2	Sufficiently Appropriate	> 8-15	38.838,08	28,48
3	Not Appropriate	> 15	13.099,35	9,61
	Total		136.366	100

Source: Analysis results, 2021

Figure 2. Suitability map of recreation space based on slope

3.2. *Analysis of the level of suitability of recreation space based on soil type*

Determination of recreation space based on soil type is used as one of the main parameters. Where the results of the analysis show that the classification is quite suitable, having the largest area, which is 106,639.46 Ha (78.2%) and the unsuitable classification has the smallest area of 1,415.2 (1.03%). More details can be seen in Table 5 and its spatial distribution in Fig. 3, where a fairly adequate classification dominates the level of suitability of the recreation space according to the gromusol and Mediterranean soil.

Table 5. Level of suitability by soil type

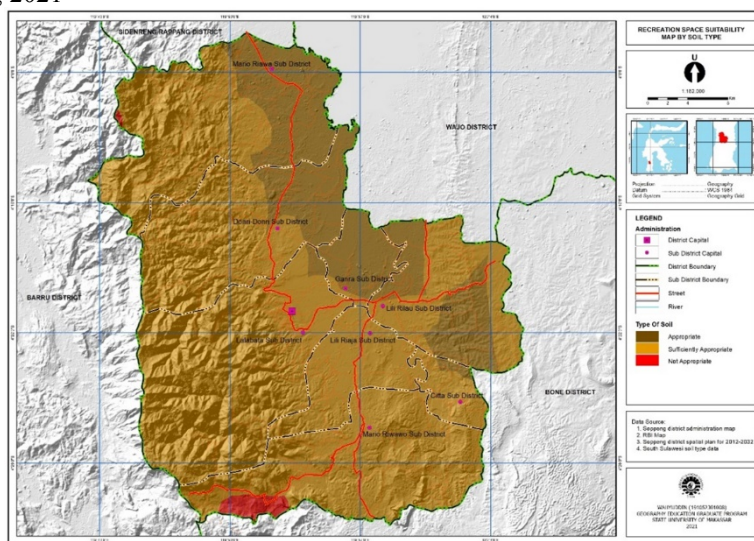| No	Classification	Type of Soil	Large	
			(Ha)	(%)
1	Appropriate	Aluvial	28.311,79	20,76
2	Sufficiently Appropriate	Gromusol	17.180,64	12,60
3		Mediteran	89.458,82	65,60
4	Not Appropriate	Regosol	88,10	0,06
5		Litosol	1.327,10	0,97
	Total		136.366	100

Source: Analysis results, 2021

Figure 3. Recreation space suitability map by soil type

3.3. *Analysis of the level of suitability of recreation space based on land use*

Image interpretation was carried out using Landsat 8 image data in 2019. Where the results of the analysis of the suitability of recreation space based on land use, the classification was obtained according to the largest area of 96,958.93 Ha (71.1%), and the criteria did not match the smallest area of 4,877.7 Ha (3,6%). More details can be seen in Table 6 and its spatial distribution in Fig 4. The level of suitability of recreational spaces is generally dominated by appropriate classification, so that in essence, Soppeng Regency has the potential to become a sustainable agro-tourism area.

Table 6. Level of suitability by land use

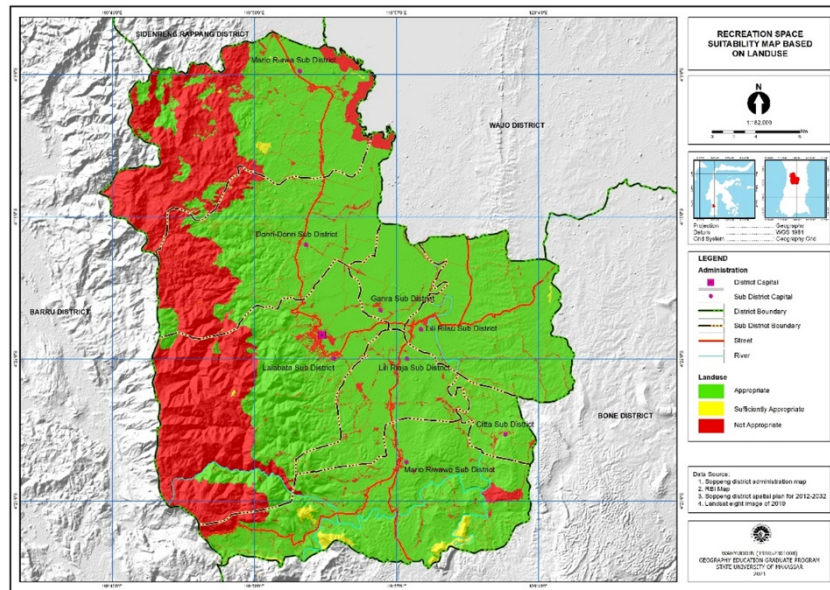| No	Classification	Landuse	Large	
			(Ha)	(%)
1	Appropriate	Field	10.001,97	7,33
2		garden	17.409,58	12,77
3		ricefield	28.564,92	20,95
4		Mixed garden	40.982,46	30,05
5	Sufficiently Appropriate	bushes and shrubs	1.280,54	0,94
6		forest	33.219,63	24,36
7	Not Appropriate	Body of water	1.430,45	1,05
8		settlement	3.477,25	2,55
	Total		136.366	100

Source: Analysis results, 2021

Figure 4. Recreation space suitability map by land use

3.4. *Analysis of Land Suitability for Agrotourism Areas*

Based on the results of the overlay analysis using the Arcgis 10.8 application using the three indicators above, the results of the suitability of agrotourism land were obtained, which were divided into three suitability zones, namely appropriate, quite suitable, and not suitable. The area suitable for agrotourism has the widest distribution, which is 72.794.28 Ha (53.52%), and the unsuitable classification has the smallest area of 28.269.02 Ha (20.87%). The results of the overlay analysis can be seen in Table 7.

Table 7. The wide distribution of overlayed agro-tourism areas

No	Classification	Large	
		(Ha)	(%)
1	Appropriate	72.983.02	53,52
2	Sufficiently Appropriate	34.918.65	25,61
3	Not Appropriate	28.464.33	20,87
	Total	136.366	100

Source: Analysis results, 2021

The identification of the spatial distribution of land suitability for agrotourism in the Soppeng Regency can be seen in Fig 5. In general, the Soppeng Regency area is dominated by area criteria suitable for agrotourism. Based on the results of the analysis and field observations, it is shown that the existing conditions in Soppeng Regency are suitable as an agro-tourism planning area. Given the abundant agro-tourism potential of Soppeng Regency, and currently has received attention from the district government, as evidenced by the existence of the Soppeng Regency Regional Regulation (Soppeng Regency Government, 2012).
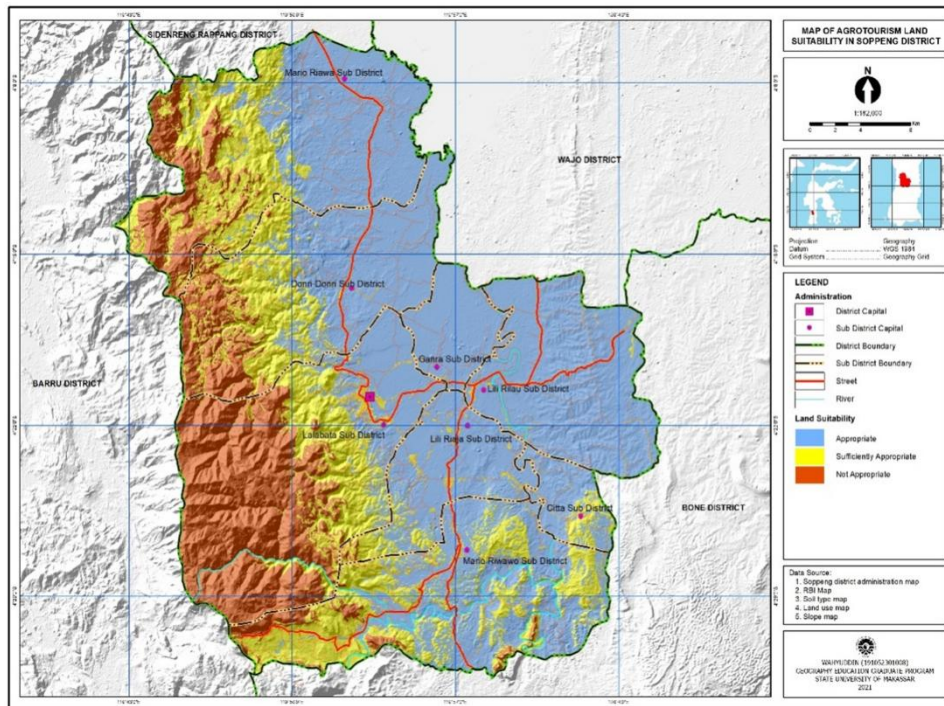
Figure 5. Agro-tourism land suitability map in Soppeng district

Identification of land suitability for agro-tourism is carried out to find out whether each area in Soppeng Regency has the potential for agrotourism development and to find out the various problems that exist. This is very important to study because, in general, the land contained in the agrotourism area includes natural resources that have a lot of potential and benefits to accommodate the socio-economic activities of the community in maximizing the environment. The current rural environment is more likely to develop towards educational tourism. This is good so that the general public can know the life and activities of farmers and create a positive image of agriculture for the next generation (Petroman et al., 2016). Thus, the results of this education can add to the public's knowledge about marketing strategies for agricultural products, of course, with the government and the community (Liang et al., 2020).

The results of the suitability for agrotourism areas based on the slope show beautiful views, especially towards the hills, which provide more visual value to attract the attention of visitors. The area of Soppeng Regency, especially in sloping to steep areas and close to resident villages, has a great opportunity to develop development and cultivation activities related to agrotourism (Gunarto, 2017). At the same time, the steep area is very important to pay attention to because this area is very prone to erosion to landslides which can endanger site users because currently there have been many minor damages due to soil erosion caused by land degradation (Huang et al., 2016). Therefore, planting plants in mountainous areas with steep slopes will provide stability to the slopes that can withstand soil movement if erosion occurs (Grima et al., 2020).

Figure 6. Some objects in Soppeng that can be developed into agrotourism

Objects that have the highest value are the location of rice fields, peanut plantations, and farms. The three object locations are located in areas suitable for agro-tourism planning. The location of the object has the condition of agro-agricultural tourism attractions and the accessibility to the location is fairly easy and is located around the main road. The object in the agro-tourism planning area that has the lowest value is the cashew plantation. Various agricultural activities are very minimal and there are only cashew plantations associated with residential areas, so it is very difficult to enjoy the natural scenery of the cashew plantations. Meanwhile, the accessibility to the location is very easy and the road conditions are smooth and paved.

Most of the objects from plantations, agriculture to livestock that have agro-tourism potential in Soppeng Regency have been equipped with various natural scenery and supporting accessibility, but in terms of the availability of tourism resources, there is still a need for improvement and performance from various parties for the convenience of visitors who travel. If these four factors have been met, the objects in the agro-tourism planning area will be formed and become one of the recommended tourist sites.

Determination of agrotourism areas is not only based on the slope. But also in terms of soil type. The results of the identification of the area's suitability found that the soil types scattered in Soppeng Regency are quite good for use as an agrotourism area because this area has good fertility and humidity levels, especially in lowland areas. The relationship between soil type and agrotourism is closely related, where soil type is the main factor of soil fertility whose function is vital for plant growth, but highland areas will usually affect soil fertility due to different agricultural management practices, regardless of soil type (Tran et al., 2021).

The results of Landsat 8 image analysis in 2019 Soppeng Regency has agro-tourism potential seen from land use. In general, it consists of forests, mixed gardens, fields, plantations, settlements, rice fields, shrubs, and bodies of water. The potential of this land is very likely to become an agrotourism attraction even though it has not been fully utilized optimally. Therefore, it is necessary to assess the suitability of appropriate land use and implement policies by the government and involve every stakeholder in order to be able to reach the right decision-making for the sustainability of agricultural tourism (Lazoglou & Angelides, 2020).

Although land use has a great opportunity as a determinant aspect of agrotourism, if its management is not regulated in such a way, it will not get maximum results. For this reason, this research can be used as a reference so that land use in Soppeng Regency can be more focused so that land use management can be cultivated and carried out optimally in order to preserve the

environment, of course with the cooperation of the community and the government as the core of environmental management (Musavengane, 2019).

In addition to slopes, soil types, and land use, hydrological factors also influence soil and plant moisture as the basic things that support human life and development (Zhou & Wang, 2019). These factors will certainly greatly affect the productivity level of the agro-tourism area because the location of Soppeng Regency is also located along the watershed so that it has the potential to irrigate the soil and crops around it (Soppeng Regency Government, 2017).

Land suitability for agro-tourism planning in Soppeng Regency resulted in 5 suitability classifications. A very suitable area stretches from the north which borders Sidenreng Rappang Regency, towards the northeast which borders Wajo Regency to the east which borders Bone Regency. Meanwhile, the appropriate area is located in the mid-administrative area of Soppeng Regency and a small part of the suitability area borders Wajo Regency and Bone Regency. While the area is quite suitable, it is also in the middle of the administration of Soppeng Regency and is bordered by Bone Regency in the south. On the other hand, the unsuitable area for agro-tourism stretches from the northwest of Soppeng Regency which borders Sidenreng Rappang Regency to parts of Barru Regency and Bone Regency, while the area that is not very suitable for agrotourism is found in a fairly steep mountainous area in the southwest of Soppeng Regency. which also borders Barru Regency.

In general, Soppeng Regency has the potential for agro-tourism development based on the analysis results using the Overlay technique that combines each of the parameters used, namely soil type, land use, etc, and slope. Furthermore, a land suitability map was made for agrotourism areas in Soppeng Regency. The overlay results produce a composite map and divide the area into three land suitability areas, namely suitable, moderately suitable, and inappropriate areas. So that in essence Soppeng Regency is suitable for agro-tourism development.

The results of the analysis can be used as an agrotourism development plan in accordance with the current conditions and development of the village. Rural tourism can contribute to the development of agro-tourism that is tailored to the objectives of sustainable regional development and contributes to cultural, economic, and social development (Kastenholz et al., 2018).

Theoretically, the development of agrotourism certainly requires tourist attractions, both natural and artificial. For the development of agrotourism in Soppeng Regency, tourist attraction aspects already exist, consisting of agricultural land, natural scenery accompanied by biodiversity. The diversity of flora and fauna has the economic potential to be marketed as a promising agro-tourism attraction (Navarro-Martínez et al., 2020). However, these tourism potentials require maintenance that pays attention to sustainable and culturally valuable ecosystems (Chen, 2020).

Efforts to develop agrotourism in Soppeng Regency take several policies which will later be used as a guide in implementing agrotourism. The designation of agrotourism areas has been determined which is located in Mariolau Village and Gattareng Village in Marioriwawo District (Soppeng Regency Government, 2012). Based on the physical analysis of the land in this study, the location is in reasonably good criteria because it needs several conditions in developing agrotourism areas because it is located in a varied topography. But these limiting factors can be addressed by planting conservation plants that can prevent landslides and managing agricultural land that pays attention to environmental aspects. This limiting factor also requires cooperation from various parties so that in the future, there will be no overlapping interests that can damage the development of agrotourism areas in Soppeng Regency.

4. Conclusion

Soppeng Regency, South Sulawesi province, Indonesia has a natural beauty in the form of a mountainous area and many agricultural crop commodities, which are quite abundant, making this area have agrotourism potentials that are feasible to be developed. Based on the results of data analysis using the overlay technique, it shows that suitable criteria for agrotourism areas dominate

Soppeng Regency in general. However, in identifying the suitability of agro-tourism in this research, it is still not perfect due to the limitations of the data analysis used. Therefore, for similar research in the future, it is hoped that it will be able to identify the suitability of agrotourism viewed from various factors (physical, biophysical, social, and economic) and, most importantly, reach the stage of planning the agrotourism landscape.

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1. Figures 1-5. The letters on the right panel are not readable. Please revise or simplify/modify.
2. Tables 4-7. Please replace "comma" with "dot" to represent a decimal value.
3. [After conclusion]. In the Acknowledgment section, there are still blank sections. Please complete.
4. [conclusion] "Therefore, for similar research in the future, it is hoped that it will be able to identify..." Please remove "it is hoped that". This is not the right way of making a conclusion.
5. Throughout the manuscript text. Please replace "comma" with "dot" to represent a decimal value.
6. Please add the objective of this study at the end of the last paragraph of the introduction.

The Utilization of Geographic Information Systems (GIS) for the Suitability of Agro-tourism Land

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Abstract
Development of environmentally friendly tourism can be interpreted as development that does not damage the environment and uses land wisely. In terms, agrotourism is a tourism activity that explore and utilize the potential of the environment in it as a tourist attraction. This study aims to determine the agrotourism area by the physical conditions of the environment in Soppeng Regency, South Sulawesi, Indonesia. Determining the suitability of agrotourism areas using quantitative descriptive methods using overlay analysis techniques or stacking parameter maps (land use, soil type, and slope) that have been scored and weighted beforehand using the Arcgis 10.8 application. The results of the overlay produce a composite map and divide the area into three classifications, namely areas that are suitable, quite suitable, and not suitable. The suitable area is 72,794 Ha (53.52%), the suitable area is 34,726.96 Ha (25.61%) and the unsuitable area is 28,269.02 Ha (20.87%). Based on the results of the analysis of several parameters above, it shows that Soppeng Regency has the potential to be used as an agrotourism area which is also supported by the various types of agricultural activities in Soppeng Regency.

Keywords: Land Suitability; Geographic Information System (GIS); Land Suitability; Agrotourism

1. Introduction

The development of the tourism industry without paying attention to environmental impacts will certainly harm humans themselves. Therefore, environmental development needs to be developed not to damage the environment and provide knowledge to the wider community (Díez-Gutiérrez and Babri, 2020). The greater public knowledge about the environment, the better the impact will be felt (Gautam, 2020). This is because tourism can be a threat in the form of conservation area expansion that can damage protected ecosystems to disrupt the sustainability of tourism potentials (Canteiro *et al*., 2018).

Indonesia's diversity of tourism potential includes natural resource-based tourism, including rural and agricultural landscapes where tourism has its charm as a destination that can provoke an increase and turn the wheels of the economy, especially for the government and society (Situmorang *et al*., 2019). Rural tourism has now developed following the times where the main focus is locations that are the main icons of natural scenery, agricultural land, and culture (Xiang *et al*., 2020). In simple terms, agrotourism is a tourism activity that utilizes the capabilities of agricultural land, processing production processes, and distributing production products in which there are activities to introduce the rural culture and preserve the environment (Kaswanto, 2015).

Various previous studies raised almost the same theme, namely agrotourism – traditional knowledge and rural biotechnology (Ciolac *et al.*, 2015) and Agrotourism as prospects, interests,

goals, and challenges in Nepal (Khanal and Shrestha, 2019). Meanwhile, in Soppeng regency, there was a study about the agrotourism to study and to analyze the potential and attractiveness of natural tourism in the Bulu Dua area and formulated a community-based nature tourism management strategy in the Bulu Dua area, Soppeng Regency (Muhammad and Darmawan, 2019). Therefore, in this research, the researchers intend to present information about the use of geographic information systems (GIS) to identify the suitability of agrotourism in Soppeng Regency, which is viewed from the physical aspect of the environment using the Overlay analysis technique (overlapping parameter maps) with the scoring and weighting method using the application. Arcgis 10.8

Diez-Gutierrez and Babri (2020) studied the development of tourism that can harm the environment. One of the factors causing increased pollution around tourist attractions comes from tourist behavior. One way to provide information to tourists is by determining the right tourist route. This study concludes that policymakers should consider improving the transportation system.

Canteiro *et al.* (2018) revealed that the threat of environmental expansion would impact the tourism sector. This study uses the Tourism Impact Assessment (TIA) method by evaluating the environmental impacts associated with nature conservation areas. The result is that fifteen tourism activities affect four biological components (biodiversity, land cover, soil, and water).

Xiang *et al.* (2020) stated that rural eco-tourism focuses on development by utilizing natural resources. Determination of standards using survey and evaluation methods in determining rural eco-tourism. This study uses the Decision Alternative Ratio Evaluation System (DARE) and the Delphi method. The research results in this scientific research show that natural conditions and the human condition are the core elements of rural eco-tourism resources.

Kaswanto (2015) studied the evaluation of agro-tourism based on four aspects, namely agriculture, tourism, beauty, and amenities (ATBA). That is, the development of natural tourism focuses on agriculture that is right for tourism. Spatial distribution of land use using Landsat image. Spatial distribution of land use using Landsat imagery. The spatial approach is used by combining the element values of each landscape. This study aims to design a land management scenario for agro-tourism using the ATBA method. At the same time, Chen (2020) discusses the environmental impacts caused by changes in environmental ecosystems. The method used to determine environmental changes using (ESV) is to assess each ecosystem.

Exploring the potential of agrotourism in Soppeng Regency, South Sulawesi province, Indonesia has been explained about the intensity of spatial use aimed at planning and developing agrotourism areas and integrating tourism activities to support the preservation of technically irrigated agricultural land (Soppeng Regency Government, 2012). Some of the objects in Soppeng that can be identified as an agricultural site such as rice fields, corn plantation, cocoa plantation, mango plantation, cashew plantation, dragon fruit plantation, watermelon plantation, peanut plantation, livestock farms, and cocoa seedling sites. This has become one of the drivers of research on agrotourism development in the Soppeng Regency. Thus, the potential for agricultural tourism, nature conservation, and culture can be maintained to preserve nature and culture as a gift from God Almighty. It is an effort to promote general welfare for the community through the development of village tourism potential by utilizing the potential of the environment and land for the benefit of tourist attractions for the welfare of the local community (Soppeng Regency Government, 2019). Add the objective of this study

2. Materials and Method

The type of research used in this research is descriptive quantitative research. Quantitative descriptive research is a research method based on the philosophy of positivism or a perspective when understanding a fact-based on empirical data, where data analysis is more statistical (Creswell and Creswell, 2017). Quantitative descriptive research is also a conscious and systematic effort to provide answers to a problem and or obtain more in-depth and broad-based information on an

incident phenomenon using the stages of a quantitative approach. Moreover, the land use data that derived from Landsat, it needs to be validated through confusion matrix. Based on the ground check and the matrix analysis, the error percentage is 15%. Hence, the land use data can be used for further analysis.

Table 1. Types and sources of research data

No	Data	Data Type	Data Source
1	Administration Map	Primary Data	Related Agencies
2	Slope	Secondary Data	Observation and Dem Srtm
3	Type Of Soil	Secondary Data	Related Agencies
4	Land Use	Primary Data	Landsat 8 Image Of 2019

2.1 Research sites

Soppeng Regency is located in South Sulawesi Province. It is divided into 8 sub-districts: Marioriwawo District, Lalabata District, Liliriaja District, Ganra District, Citta District, Lilirilau Donri-Donri District, and Marioriawa District. Marioriawa District is the largest sub-district, with an area of 320 km2 or about 21.3% of the total area of Soppeng Regency. Meanwhile, the Citta sub-district is the sub-district with the smallest area, which is only 40 km2 or 2.7 percent of the total area of Soppeng Regency. Soppeng Regency is geographically located at coordinates 4 6'00" - 4 32'00" South Latitude and 119˚47'18" - 120 06'13" East Longitude as shown in Figure 1 below.
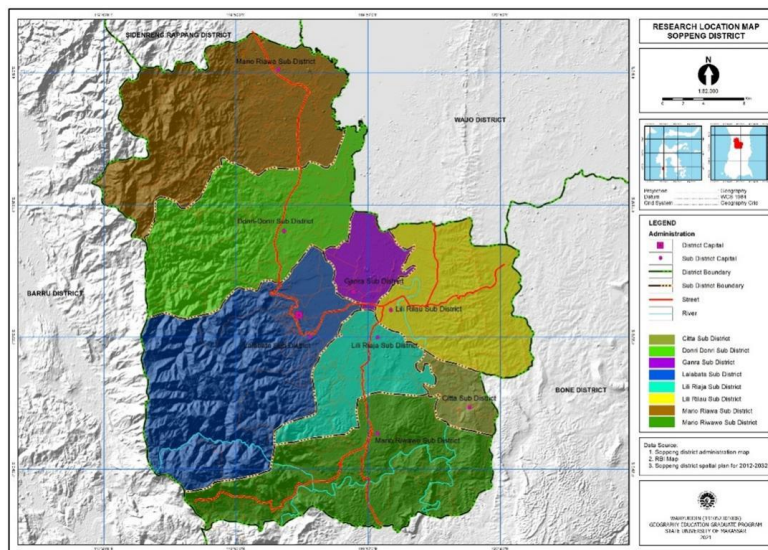

Figure 1. Research location map (the details are difficult to read)

Soppeng Regency boundaries include:
a. North side: Sidenreng Rappang Regency
b. East: Wajo Regency and Bone Regency
c. Southside: Bone Regency
d. West: Barru Regency

Comment [P1]: What are a, b, c, and d in the figure? Are they the explanation the figure?

Soppeng Regency is surrounded by a vast mountainous landscape and a topography that varies from flat to steep with natural characteristics typical of the countryside. The research location has various agricultural and plantation resources and natural and artificial landscapes that have high enough potential to be used as agro-tourism objects.

2.2 Agrotourism Land Suitability Zone Analysis

In the context of tourism areas, planning is a systematic tool used to determine the initial moment of a situation and the best way to achieve it. Regional planning is carried out through several approaches, one of which is the natural resource approach, namely character determination and alternative recreation and tourism activities based on the results of monitoring the conditions and condition of the resources. In assessing physical conditions, land use, slope, and soil type can be important indicators in accordance with the recommendations of several experts and existing regulations.

Spatial analysis uses ArcGIS 10.8 software and overlay technique or parameter stacking after determining each criterion and scoring (Table 2 and Table 3). The spatial method is based on the slope, land use, and erosion sensitivity according to soil type.

Table 2. Assessment criteria and a recreational room suitability score

Aspects	Standards of Conformity	Criteria	Score
Land Use	There is no building structure and other vegetation other than the ground cover. The site is dominated by open land use.	fits	3
	The site is still quite dominated by open land use, but there are several structures and buildings and vegetation other than the ground cover.	Sufficiently Suitable	2
	Dominant site with Incompatible building	not suitable	1
Slope	0-8 % (Flat and Sloping)	Appropriate	3
	8-15 % (Slightly Steep)	Fairly Appropriate	2
	>15 % (Steep and Steep)	not suitable	1

*good=3, moderate=2, bad= 1, Source: (Hardjowigeno, 2007)

Table 3. Assessment criteria and conformity score sensitivity to erosion

Aspects	Standards of Conformity	Criteria	Score
Soil Type	Alluvial, Glei Planosol Hydromorphic Gray Soil, Literita Groundwater, Suitable Latosol	Suitable Latosol (Not Erosion Sensitive)	3
	Brown Forest Soil, Non Calcis Brown, Mediteran, Andosol, Laterit, grumosol, podsol, podsolik	Sufficiently (Sensitive erosion)	2
	Regosol, Litosol, organosol, renzina	Incompatible (Sensitive erosion)	1

*good=3, moderate=2, bad=1, Source: (Ministry of Agriculture, 1980)

Based on the assessment criteria and the score for the suitability of the recreation space above, a land suitability map for the designation of agrotourism areas in Soppeng was compiled. The determination of the classification level is as follows:

Classification of Potential Levels $\frac{\text{N Maximum} - \text{N Minimum Scores}}{\text{N Classification Levels}}$

From the calculation of the scores for each parameter, the criteria for the suitability class were obtained. The results of the assessment of tourist areas are clarified as A (Appropriate), SA (Sufficiently Appropriate), and NA (Not Appropriate)

3. Results and Discussion

3.1 Analysis of the level of suitability of recreation space based on the slope of the slope

Slope data obtained from DEM SRTM 30 meters resolution. The results showed that the area that is suitable to be used as an agrotourism area has an area of 84.429,42 Ha (61,91%), while the area that is not suitable has an area of 13.099,35 Ha (9,61%) of the total area of Soppeng Regency. The results of the analysis can be seen in Table 4. The distribution can be seen in Fig 2, which generally shows the appropriate criteria.

Table 4. Level of suitability based on slope

No	Classification	Slope (%)	Large	
			(Ha)	(%)
1	Appropriate	0-8	84.429,42	61,91
2	Sufficiently Appropriate	> 8-15	38.838,08	28,48
3	Not Appropriate	> 15	13.099,35	9,61
	Total		136.366	100

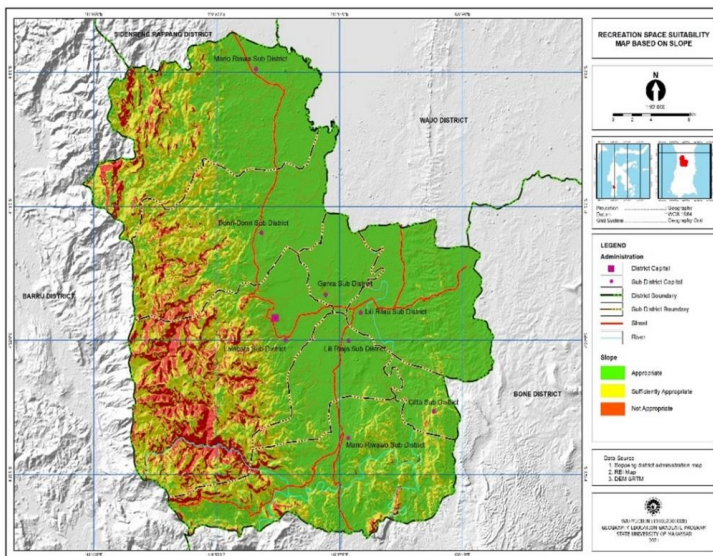Source: Analysis results, 2021 Column (Ha) and % the numerical are so strange, What?

Figure 2. Suitability map of recreation space based on slope
Same as Figure 1 difficult to read

3.2 Analysis of the level of suitability of recreation space based on soil type

Determination of recreation space based on soil type is used as one of the main parameters. Where the results of the analysis show that the classification is quite suitable, having the largest area, which is 106,639.46 Ha (78.2%) and the unsuitable classification has the smallest area of 1,415.2

(1.03%). More details can be seen in Table 5 and its spatial distribution in Fig. 3, where a fairly adequate classification dominates the level of suitability of the recreation space according to the gromusol and Mediterranean soil.

Table 5. Level of suitability by soil type

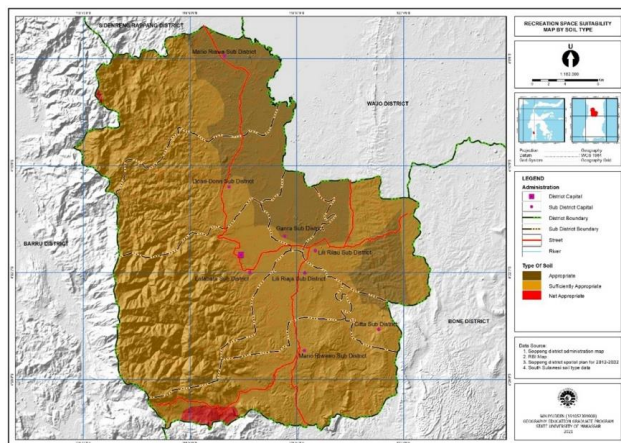| No	Classification	Type of Soil	Large	
			(Ha)	**(%)**
1	Appropriate	Aluvial	28.311,79	20,76
2	Sufficiently Appropriate	Gromusol	17.180,64	12,60
3		Mediteran	89.458,82	65,60
4	Not Appropriate	Regosol	88,10	0,06
5		Litosol	1.327,10	0,97
	Total		136.366	100

Source: Analysis results, 2021

Figure 3. Recreation space suitability map by soil type
Same as figure 1 and 2 difficult to read

3.3 Analysis of the level of suitability of recreation space based on land use

Image interpretation was carried out using Landsat 8 image data in 2019. Where the results of the analysis of the suitability of recreation space based on land use, the classification was obtained according to the largest area of 96,958.93 Ha (71.1%), and the criteria did not match the smallest area of 4,877.7 Ha (3,6%). More details can be seen in Table 6 and its spatial distribution in Fig 4. The level of suitability of recreational spaces is generally dominated by appropriate classification, so that in essence, Soppeng Regency has the potential to become a sustainable agro-tourism area.

Table 6. Level of suitability by land use

No	Classification	Landuse	Large	
			(Ha)	**(%)**
1	Appropriate	Field	10.001,97	7,33
2		garden	17.409,58	12,77
3		ricefield	28.564,92	20,95
4		Mixed garden	40.982,46	30,05

5	Sufficiently Appropriate	bushes and shrubs	1.280,54	0,94
6		forest	33.219,63	24,36
7	Not Appropriate	Body of water	1.430,45	1,05
8		settlement	3.477,25	2,55
	Total		136.366	100

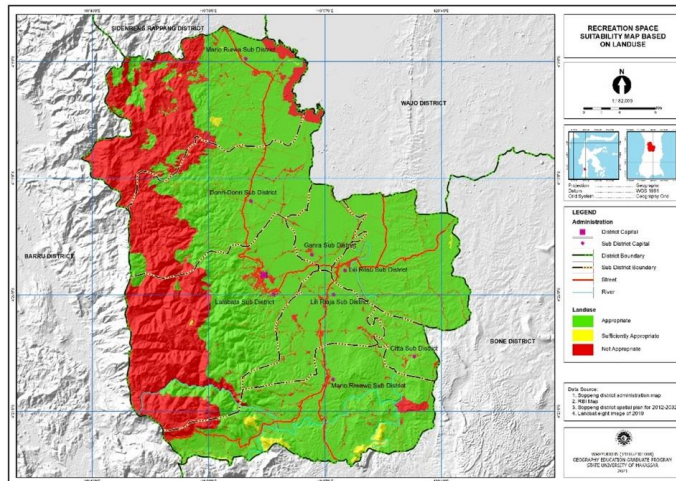Source: Analysis results, 2021

Figure 4. Recreation space suitability map by land use

3.4 Analysis of Land Suitability for Agrotourism Areas

Based on the results of the overlay analysis using the Arcgis 10.8 application using the three indicators above, the results of the suitability of agrotourism land were obtained, which were divided into three suitability zones, namely appropriate, quite suitable, and not suitable. The area suitable for agrotourism has the widest distribution, which is 72.794.28 Ha (53.52%), and the unsuitable classification has the smallest area of 28.269.02 Ha (20.87%). The results of the overlay analysis can be seen in Table 7.

Table 7. The wide distribution of overlayed agro-tourism areas

No	Classification	Large	
		(Ha)	(%)
1	Appropriate	72.983.02	53,52
2	Sufficiently Appropriate	34.918.65	25,61
3	Not Appropriate	28.464.33	20,87
	Total	136.366	100

Source: Analysis results, 2021

The identification of the spatial distribution of land suitability for agrotourism in the Soppeng Regency can be seen in Figure 5. In general, the Soppeng Regency area is dominated by area criteria suitable for agrotourism. Based on the results of the analysis and field observations, it is shown that the existing conditions in Soppeng Regency are suitable as an agro-tourism planning area. Given the abundant agro-tourism potential of Soppeng Regency, and currently has received attention from the

district government, as evidenced by the existence of the Soppeng Regency Regional Regulation (Soppeng Regency Government, 2012).
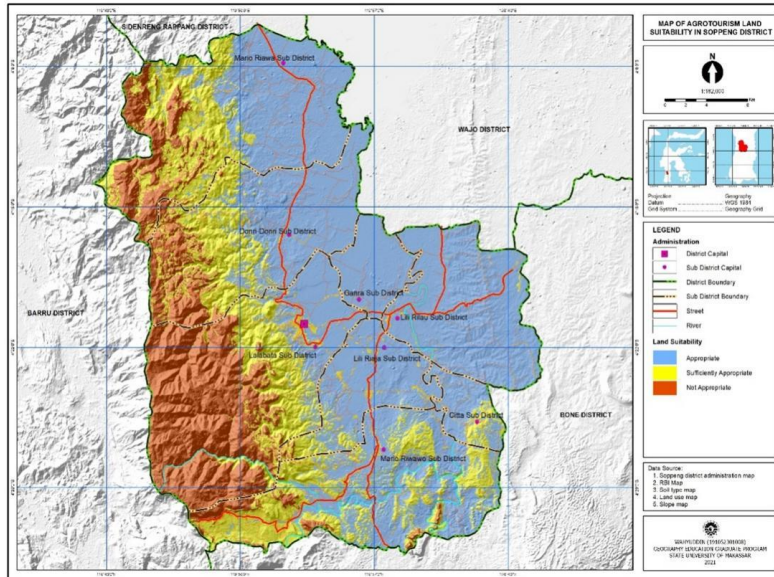

Figure 5. Agro-tourism land suitability map in Soppeng district

Identification of land suitability for agro-tourism is carried out to find out whether each area in Soppeng Regency has the potential for agrotourism development and to find out the various problems that exist. This is very important to study because, in general, the land contained in the agrotourism area includes natural resources that have a lot of potential and benefits to accommodate the socio-economic activities of the community in maximizing the environment. The current rural environment is more likely to develop towards educational tourism. This is good so that the general public can know the life and activities of farmers and create a positive image of agriculture for the next generation (Petroman *et al.*, 2016). Thus, the results of this education can add to the public's knowledge about marketing strategies for agricultural products, of course, with the government and the community (Liang *et al.*, 2020).

The results of the suitability for agrotourism areas based on the slope show beautiful views, especially towards the hills, which provide more visual value to attract the attention of visitors. The area of Soppeng Regency, especially in sloping to steep areas and close to resident villages, has a great opportunity to develop development and cultivation activities related to agrotourism (Gunarto, 2017). At the same time, the steep area is very important to pay attention to because this area is very prone to erosion to landslides which can endanger site users because currently there have been many minor damages due to soil erosion caused by land degradation (Huang et al., 2016). Therefore, planting plants in mountainous areas with steep slopes will provide stability to the slopes that can withstand soil movement if erosion occurs (Grima *et al.*, 2020).

Figure 6. Some objects in Soppeng that can be developed into agrotourism

Objects that have the highest value are the location of rice fields, peanut plantations, and farms. The three object locations are located in areas suitable for agro-tourism planning. The location of the object has the condition of agro-agricultural tourism attractions and the accessibility to the location is fairly easy and is located around the main road. The object in the agro-tourism planning area that has the lowest value is the cashew plantation. Various agricultural activities are very minimal and there are only cashew plantations associated with residential areas, so it is very difficult to enjoy the natural scenery of the cashew plantations. Meanwhile, the accessibility to the location is very easy and the road conditions are smooth and paved.

Most of the objects from plantations, agriculture to livestock that have agro-tourism potential in Soppeng Regency have been equipped with various natural scenery and supporting accessibility, but in terms of the availability of tourism resources, there is still a need for improvement and performance from various parties for the convenience of visitors who travel. If these four factors have been met, the objects in the agro-tourism planning area will be formed and become one of the recommended tourist sites.

Determination of agrotourism areas is not only based on the slope. But also in terms of soil type. The results of the identification of the area's suitability found that the soil types scattered in Soppeng Regency are quite good for use as an agrotourism area because this area has good fertility and humidity levels, especially in lowland areas. The relationship between soil type and agrotourism is closely related, where soil type is the main factor of soil fertility whose function is vital for plant growth, but highland areas will usually affect soil fertility due to different agricultural management practices, regardless of soil type (Tran et al., 2021).

The results of Landsat 8 image analysis in 2019 Soppeng Regency has agro-tourism potential seen from land use. In general, it consists of forests, mixed gardens, fields, plantations, settlements, rice fields, shrubs, and bodies of water. The potential of this land is very likely to become an agrotourism attraction even though it has not been fully utilized optimally. Therefore, it is necessary to assess the suitability of appropriate land use and implement policies by the government and involve every stakeholder in order to be able to reach the right decision-making for the sustainability of agricultural tourism (Lazoglou & Angelides, 2020).

Although land use has a great opportunity as a determinant aspect of agrotourism, if its management is not regulated in such a way, it will not get maximum results. For this reason, this research can be used as a reference so that land use in Soppeng Regency can be more focused so that land use management can be cultivated and carried out optimally in order to preserve the

environment, of course with the cooperation of the community and the government as the core of environmental management (Musavengane, 2019).

In addition to slopes, soil types, and land use, hydrological factors also influence soil and plant moisture as the basic things that support human life and development (Zhou & Wang, 2019). These factors will certainly greatly affect the productivity level of the agro-tourism area because the location of Soppeng Regency is also located along the watershed so that it has the potential to irrigate the soil and crops around it (Soppeng Regency Government, 2017).

Land suitability for agro-tourism planning in Soppeng Regency resulted in 5 suitability classifications. A very suitable area stretches from the north which borders Sidenreng Rappang Regency, towards the northeast which borders Wajo Regency to the east which borders Bone Regency. Meanwhile, the appropriate area is located in the mid-administrative area of Soppeng Regency and a small part of the suitability area borders Wajo Regency and Bone Regency. While the area is quite suitable, it is also in the middle of the administration of Soppeng Regency and is bordered by Bone Regency in the south. On the other hand, the unsuitable area for agro-tourism stretches from the northwest of Soppeng Regency which borders Sidenreng Rappang Regency to parts of Barru Regency and Bone Regency, while the area that is not very suitable for agrotourism is found in a fairly steep mountainous area in the southwest of Soppeng Regency. which also borders Barru Regency.

In general, Soppeng Regency has the potential for agro-tourism development based on the analysis results using the Overlay technique that combines each of the parameters used, namely soil type, land use, etc, and slope. Furthermore, a land suitability map was made for agrotourism areas in Soppeng Regency. The overlay results produce a composite map and divide the area into three land suitability areas, namely suitable, moderately suitable, and inappropriate areas. So that in essence Soppeng Regency is suitable for agro-tourism development.

The results of the analysis can be used as an agrotourism development plan in accordance with the current conditions and development of the village. Rural tourism can contribute to the development of agro-tourism that is tailored to the objectives of sustainable regional development and contributes to cultural, economic, and social development (Kastenholz *et al.*, 2018).

Theoretically, the development of agrotourism certainly requires tourist attractions, both natural and artificial. For the development of agrotourism in Soppeng Regency, tourist attraction aspects already exist, consisting of agricultural land, natural scenery accompanied by biodiversity. The diversity of flora and fauna has the economic potential to be marketed as a promising agro-tourism attraction (Navarro-Martínez *et al.*, 2020). However, these tourism potentials require maintenance that pays attention to sustainable and culturally valuable ecosystems (Chen, 2020).

Efforts to develop agrotourism in Soppeng Regency take several policies which will later be used as a guide in implementing agrotourism. The designation of agrotourism areas has been determined which is located in Mariolau Village and Gattareng Village in Marioriwawo District (Soppeng Regency Government, 2012). Based on the physical analysis of the land in this study, the location is in reasonably good criteria because it needs several conditions in developing agrotourism areas because it is located in a varied topography. But these limiting factors can be addressed by planting conservation plants that can prevent landslides and managing agricultural land that pays attention to environmental aspects. This limiting factor also requires cooperation from various parties so that in the future, there will be no overlapping interests that can damage the development of agrotourism areas in Soppeng Regency.

4. Conclusion

Soppeng Regency, South Sulawesi province, Indonesia has a natural beauty in the form of a mountainous area and many agricultural crop commodities, which are quite abundant, making this area have agrotourism potentials that are feasible to be developed. Based on the results of data

analysis using the overlay technique, it shows that suitable criteria for agrotourism areas dominate Soppeng Regency in general. However, in identifying the suitability of agro-tourism in this research, it is still not perfect due to the limitations of the data analysis used. Therefore, for similar research in the future, it is hoped that it will be able to identify the suitability of agrotourism viewed from various factors (physical, biophysical, social, and economic) and, most importantly, reach the stage of planning the agrotourism landscape.

Do you have not acknowledgement?

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Drs. H. Sukri Nyompa, SH, M.Si., Ph.D. UNM <sukrinyompa@unm.ac.id>   13 Desember 2022 pukul 12.14
Kepada: EnvironmentAsia Journal <environmentasiajournal@gmail.com>

Dear Editor,

Thank you for the feedback.
We have revised the manuscript according to the additional comments in the attached file.

Best regards,
Sukri Nyompa

[Kutipan teks disembunyikan]

📄 **(fix) EA-Revision-053-The Utilization of Geographic Information Systems for the Suitability of Agro tourism Land (1) (1).docx**
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The Utilization of Geographic Information Systems (GIS) for the Suitability of Agro-tourism Land

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Abstract

Development of environmentally friendly tourism can be interpreted as development that does not damage the environment and uses land wisely. In terms, agrotourism is a tourism activity that explore and utilize the potential of the environment in it as a tourist attraction. This study aims to determine the agrotourism area by the physical conditions of the environment in Soppeng Regency, South Sulawesi, Indonesia. Determining the suitability of agrotourism areas using quantitative descriptive methods using overlay analysis techniques or stacking parameter maps (land use, soil type, and slope) that have been scored and weighted beforehand using the Arcgis 10.8 application. The results of the overlay produce a composite map and divide the area into three classifications, namely areas that are suitable, quite suitable, and not suitable. The suitable area is 72794 Ha (53.52%), the suitable area is 34726.96 Ha (25.61%) and the unsuitable area is 28269.02 Ha (20.87%). Based on the results of the analysis of several parameters above, it shows that Soppeng Regency has the potential to be used as an agrotourism area which is also supported by the various types of agricultural activities in Soppeng Regency.

Keywords: Land Suitability; Geographic Information System (GIS); Land Suitability; Agrotourism

1. Introduction

The development of the tourism industry without paying attention to environmental impacts will certainly harm humans themselves. Therefore, environmental development needs to be developed not to damage the environment and provide knowledge to the wider community (Díez-Gutiérrez and Babri, 2020). The greater public knowledge about the environment, the better the impact will be felt (Gautam, 2020). This is because tourism can be a threat in the form of conservation area expansion that can damage protected ecosystems to disrupt the sustainability of tourism potentials (Canteiro *et al.*, 2018).

Indonesia's diversity of tourism potential includes natural resource-based tourism, including rural and agricultural landscapes where tourism has its charm as a destination that can provoke an increase and turn the wheels of the economy, especially for the government and society (Situmorang *et al.*, 2019). Rural tourism has now developed following the times where the main focus is locations that are the main icons of natural scenery, agricultural land, and culture (Xiang *et al.*, 2020). In simple terms, agrotourism is a tourism activity that utilizes the capabilities of agricultural land, processing production processes, and distributing production products in which there are activities to introduce the rural culture and preserve the environment (Kaswanto, 2015).

Various previous studies raised almost the same theme, namely agrotourism – traditional knowledge and rural biotechnology (Ciolac *et al.*, 2015) and Agrotourism as prospects, interests, goals, and challenges in Nepal (Khanal and Shrestha, 2019). Meanwhile, in Soppeng regency, there was a study about the agrotourism to study and to analyze the potential and attractiveness of natural tourism in the Bulu Dua area and formulated a community-based nature tourism management strategy in the Bulu Dua area, Soppeng Regency (Muhammad and Darmawan, 2019).

Diez-Gutierrez and Babri (2020) studied the development of tourism that can harm the environment. One of the factors causing increased pollution around tourist attractions comes from tourist behavior. One way to provide information to tourists is by determining the right tourist route. This study concludes that policymakers should consider improving the transportation system.

Canteiro *et al.* (2018) revealed that the threat of environmental expansion would impact the tourism sector. This study uses the Tourism Impact Assessment (TIA) method by evaluating the environmental impacts associated with nature conservation areas. The result is that fifteen tourism activities affect four biological components (biodiversity, land cover, soil, and water).

Xiang *et al.* (2020) stated that rural eco-tourism focuses on development by utilizing natural resources. Determination of standards using survey and evaluation methods in determining rural eco-tourism. This study uses the Decision Alternative Ratio Evaluation System (DARE) and the Delphi method. The research results in this scientific research show that natural conditions and the human condition are the core elements of rural eco-tourism resources.

Kaswanto (2015) studied the evaluation of agro-tourism based on four aspects, namely agriculture, tourism, beauty, and amenities (ATBA). That is, the development of natural tourism focuses on agriculture that is right for tourism. Spatial distribution of land use using Landsat image. Spatial distribution of land use using Landsat imagery. The spatial approach is used by combining the element values of each landscape. This study aims to design a land management scenario for agro-tourism using the ATBA method. At the same time, Chen (2020) discusses the environmental impacts caused by changes in environmental ecosystems. The method used to determine environmental changes using (ESV) is to assess each ecosystem.

Exploring the potential of agrotourism in Soppeng Regency, South Sulawesi province, Indonesia has been explained about the intensity of spatial use aimed at planning and developing agrotourism areas and integrating tourism activities to support the preservation of technically irrigated agricultural land (Soppeng Regency Government, 2012). Some of the objects in Soppeng that can be identified as an agricultural site such as rice fields, corn plantation, cocoa plantation, mango plantation, cashew plantation, dragon fruit plantation, watermelon plantation, peanut plantation, livestock farms, and cocoa seedling sites. This has become one of the drivers of research on agrotourism development in the Soppeng Regency. Thus, the potential for agricultural tourism, nature conservation, and culture can be maintained to preserve nature and culture as a gift from God Almighty. It is an effort to promote general welfare for the community through the development of village tourism potential by utilizing the potential of the environment and land for the benefit of tourist attractions for the welfare of the local community (Soppeng Regency Government, 2019).

All in all, in this research, the researchers intend to present information about the use of geographic information systems (GIS) to identify the suitability of agrotourism in Soppeng Regency, which is viewed from the physical aspect of the environment using the Overlay analysis technique (overlapping parameter maps) with the scoring and weighting method using the application. Arcgis 10.8.

2. Materials and Method

The type of research used in this research is descriptive quantitative research. Quantitative descriptive research is a research method based on the philosophy of positivism or a perspective when understanding a fact-based on empirical data, where data analysis is more statistical (Creswell

and Creswell, 2017). Quantitative descriptive research is also a conscious and systematic effort to provide answers to a problem and or obtain more in-depth and broad-based information on an incident phenomenon using the stages of a quantitative approach. Moreover, the land use data that derived from Landsat, it needs to be validated through confusion matrix. Based on the ground check and the matrix analysis, the error percentage is 15%. Hence, the land use data can be used for further analysis.

Table 1. Types and sources of research data

No	Data	Data Type	Data Source
1	Administration Map	Primary Data	Related Agencies
2	Slope	Secondary Data	Observation and Dem Srtm
3	Type Of Soil	Secondary Data	Related Agencies
4	Land Use	Primary Data	Landsat 8 Image Of 2019

2.1 Research sites

Soppeng Regency is located in South Sulawesi Province. It is divided into 8 sub-districts: Marioriwawo District, Lalabata District, Liliriaja District, Ganra District, Citta District, Lilirilau Donri-Donri District, and Marioriawa District. Marioriawa District is the largest sub-district, with an area of 320 km2 or about 21.3% of the total area of Soppeng Regency. Meanwhile, the Citta sub-district is the sub-district with the smallest area, which is only 40 km2 or 2.7 percent of the total area of Soppeng Regency. Soppeng Regency is geographically located at coordinates 4 6'00" - 4 32'00" South Latitude and 119° 47'18" - 120 06'13" East Longitude as shown in Figure 1 below.
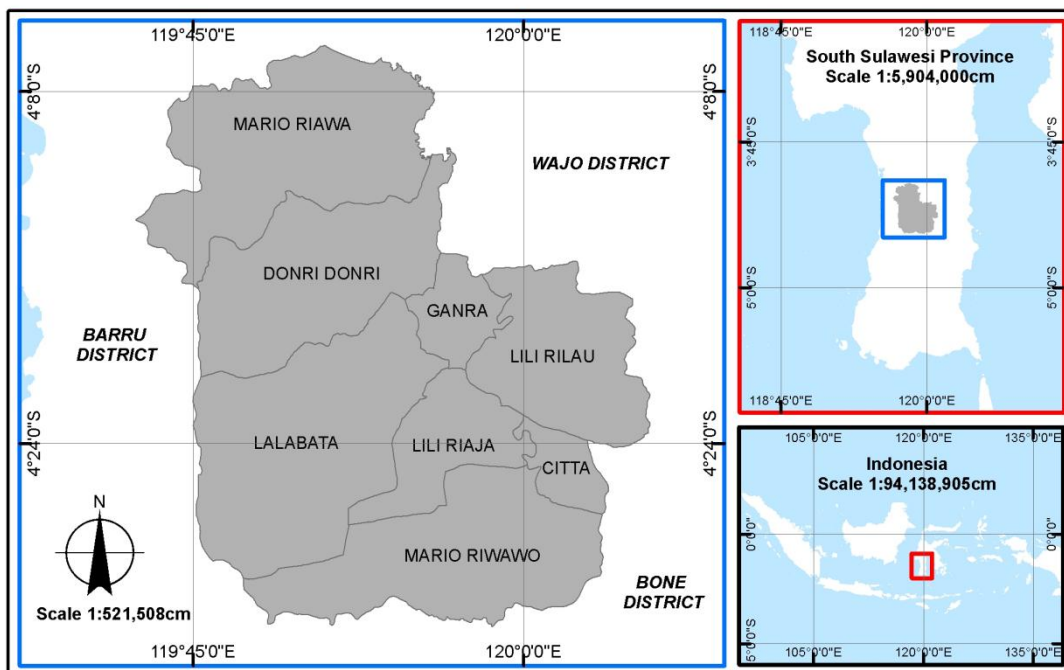

Figure 1. Research location map

Soppeng Regency is surrounded by a vast mountainous landscape and a topography that varies from flat to steep with natural characteristics typical of the countryside. The research location has various agricultural and plantation resources and natural and artificial landscapes that have high enough potential to be used as agro-tourism objects.

2.2 Agrotourism Land Suitability Zone Analysis

In the context of tourism areas, planning is a systematic tool used to determine the initial moment of a situation and the best way to achieve it. Regional planning is carried out through several approaches, one of which is the natural resource approach, namely character determination and alternative recreation and tourism activities based on the results of monitoring the conditions and condition of the resources. In assessing physical conditions, land use, slope, and soil type can be important indicators in accordance with the recommendations of several experts and existing regulations.

Spatial analysis uses ArcGIS 10.8 software and overlay technique or parameter stacking after determining each criterion and scoring (Table 2 and Table 3). The spatial method is based on the slope, land use, and erosion sensitivity according to soil type.

Table 2. Assessment criteria and a recreational room suitability score

Aspects	Standards of Conformity	Criteria	Score
Land Use	There is no building structure and other vegetation other than the ground cover. The site is dominated by open land use.	fits	3
	The site is still quite dominated by open land use, but there are several structures and buildings and vegetation other than the ground cover.	Sufficiently Suitable	2
	Dominant site with Incompatible building	not suitable	1
Slope	0-8 % (Flat and Sloping)	Appropriate	3
	8-15 % (Slightly Steep)	Fairly Appropriate	2
	>15 % (Steep and Steep)	not suitable	1

*good=3, moderate=2, bad= 1, Source: (Hardjowigeno, 2007)

Table 3. Assessment criteria and conformity score sensitivity to erosion

Aspects	Standards of Conformity	Criteria	Score
Soil Type	Alluvial, Glei Planosol Hydromorphic Gray Soil, Literita Groundwater, Suitable Latosol	Suitable Latosol (Not Erosion Sensitive)	3
	Brown Forest Soil, Non Calcis Brown, Mediteran, Andosol, Laterit, grumosol, podsol, podsolik	Sufficiently (Sensitive erosion)	2
	Regosol, Litosol, organosol, renzina	Incompatible (Sensitive erosion)	1

*good=3, moderate=2, bad=1, Source: (Ministry of Agriculture, 1980)

Based on the assessment criteria and the score for the suitability of the recreation space above, a land suitability map for the designation of agrotourism areas in Soppeng was compiled. The determination of the classification level is as follows:

From the calculation of the scores for each parameter, the criteria for the suitability class were obtained. The results of the assessment of tourist areas are clarified as A (Appropriate), SA (Sufficiently Appropriate), and NA (Not Appropriate)

3. Results and Discussion

3.1 Analysis of the level of suitability of recreation space based on the slope of the slope

Slope data obtained from DEM SRTM 30 meters resolution. The results showed that the area that is suitable to be used as an agrotourism area has an area of 84429.42 Ha (61.91%), while the area that is not suitable has an area of 13099.35 Ha (9.61%) of the total area of Soppeng Regency. The results of the analysis can be seen in Table 4. The distribution can be seen in Fig 2, which generally shows the appropriate criteria.

Table 4. Level of suitability based on slope

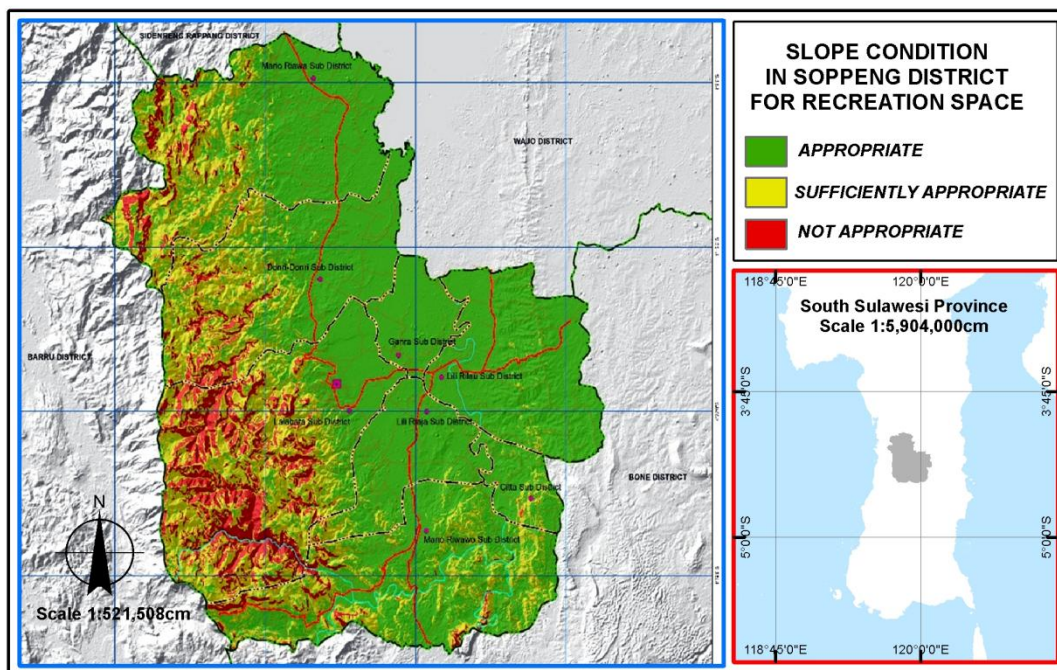| No	Classification	Slope (%)	Large	
			(Ha)	(%)
1	Appropriate	0-8	84429.42	61.91
2	Sufficiently Appropriate	> 8-15	38838.08	28.48
3	Not Appropriate	> 15	13099.35	9.61
	Total		136366	100

Source: Analysis results, 2021

Figure 2. Suitability map of recreation space based on slope

3.2 Analysis of the level of suitability of recreation space based on soil type

Determination of recreation space based on soil type is used as one of the main parameters. Where the results of the analysis show that the classification is quite suitable, having the largest area, which is 106639.46 Ha (78.2%) and the unsuitable classification has the smallest area of 1415.2 (1.03%). More details can be seen in Table 5 and its spatial distribution in Fig. 3, where a fairly adequate classification dominates the level of suitability of the recreation space according to the gromusol and Mediterranean soil.

Table 5. Level of suitability by soil type

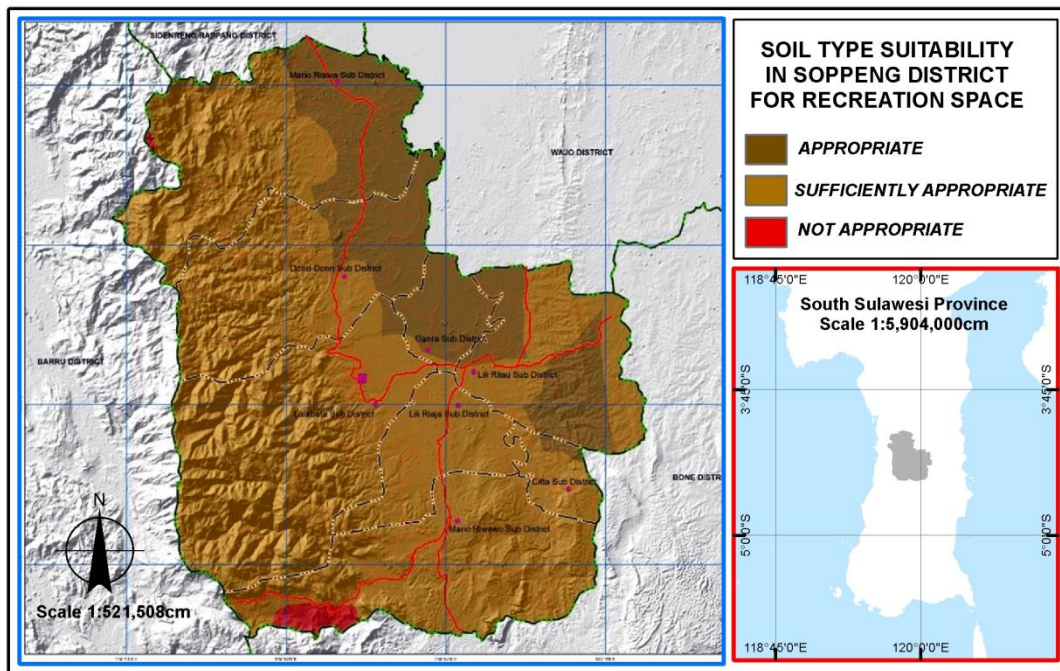| No	Classification	Type of Soil	Large	
			(Ha)	**(%)**
1	Appropriate	Aluvial	28311.79	20.76
2	Sufficiently Appropriate	Gromusol	17180.64	12.60
3		Mediteran	89458.82	65.60
4	Not Appropriate	Regosol	88.10	0.06
5		Litosol	1327.10	0.97
	Total		136366	100

Source: Analysis results, 2021

Figure 3. Recreation space suitability map by soil type

3.3 Analysis of the level of suitability of recreation space based on land use

Image interpretation was carried out using Landsat 8 image data in 2019. Where the results of the analysis of the suitability of recreation space based on land use, the classification was obtained according to the largest area of 96958.93 Ha (71.1%), and the criteria did not match the smallest area of 4877.7 Ha (3.6%). More details can be seen in Table 6 and its spatial distribution in Fig 4. The level of suitability of recreational spaces is generally dominated by appropriate classification, so that in essence, Soppeng Regency has the potential to become a sustainable agro-tourism area.

Table 6. Level of suitability by land use

No	Classification	Landuse	Large	
			(Ha)	**(%)**
1	Appropriate	Field	10001.97	7.33
2		garden	17409.58	12.77
3		ricefield	28564.92	20.95
4		Mixed garden	40982.46	30.05

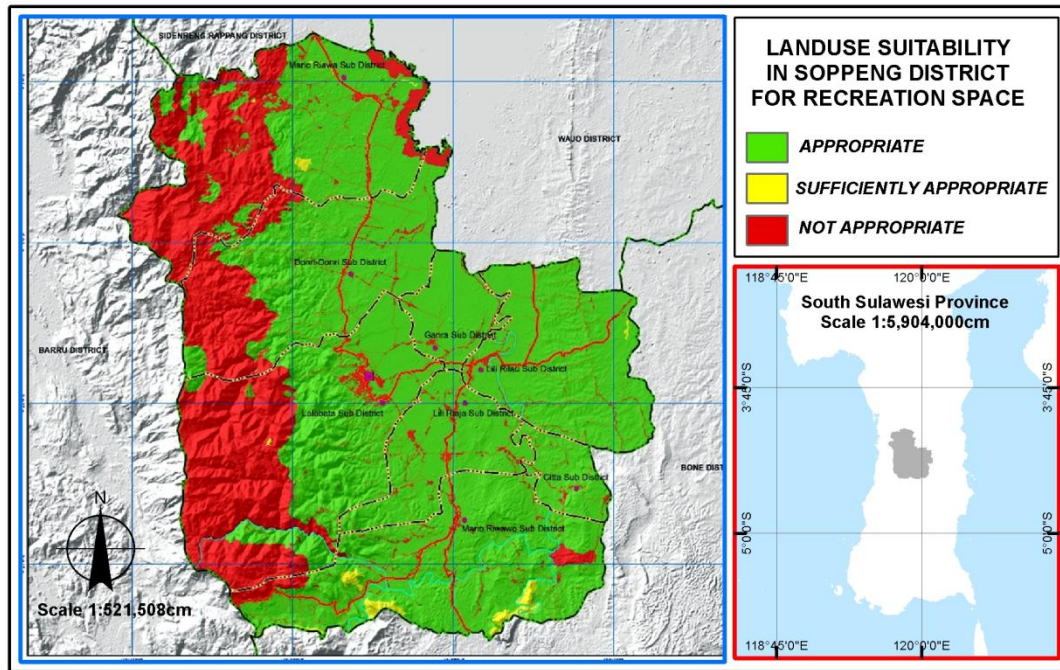| 5	Sufficiently Appropriate	bushes and shrubs	1280.54	0.94
6		forest	33219.63	24.36
7	Not Appropriate	Body of water	1430.45	1.05
8		settlement	3477.25	2.55
	Total		136366	100

Source: Analysis results, 2021

Figure 4. Recreation space suitability map by land use

3.4 Analysis of Land Suitability for Agrotourism Areas

Based on the results of the overlay analysis using the Arcgis 10.8 application using the three indicators above, the results of the suitability of agrotourism land were obtained, which were divided into three suitability zones, namely appropriate, quite suitable, and not suitable. The area suitable for agrotourism has the widest distribution, which is 72794.28 Ha (53.52%), and the unsuitable classification has the smallest area of 28269.02 Ha (20.87%). The results of the overlay analysis can be seen in Table 7.

Table 7. The wide distribution of overlayed agro-tourism areas

No	Classification	Large	
		(Ha)	(%)
1	Appropriate	72983.02	53.52
2	Sufficiently Appropriate	34918.65	25.61
3	Not Appropriate	28464.33	20.87
	Total	136366	100

Source: Analysis results, 2021

The identification of the spatial distribution of land suitability for agrotourism in the Soppeng Regency can be seen in Figure 5. In general, the Soppeng Regency area is dominated by area criteria suitable for agrotourism. Based on the results of the analysis and field observations, it is shown that

the existing conditions in Soppeng Regency are suitable as an agro-tourism planning area. Given the abundant agro-tourism potential of Soppeng Regency, and currently has received attention from the district government, as evidenced by the existence of the Soppeng Regency Regional Regulation (Soppeng Regency Government, 2012).
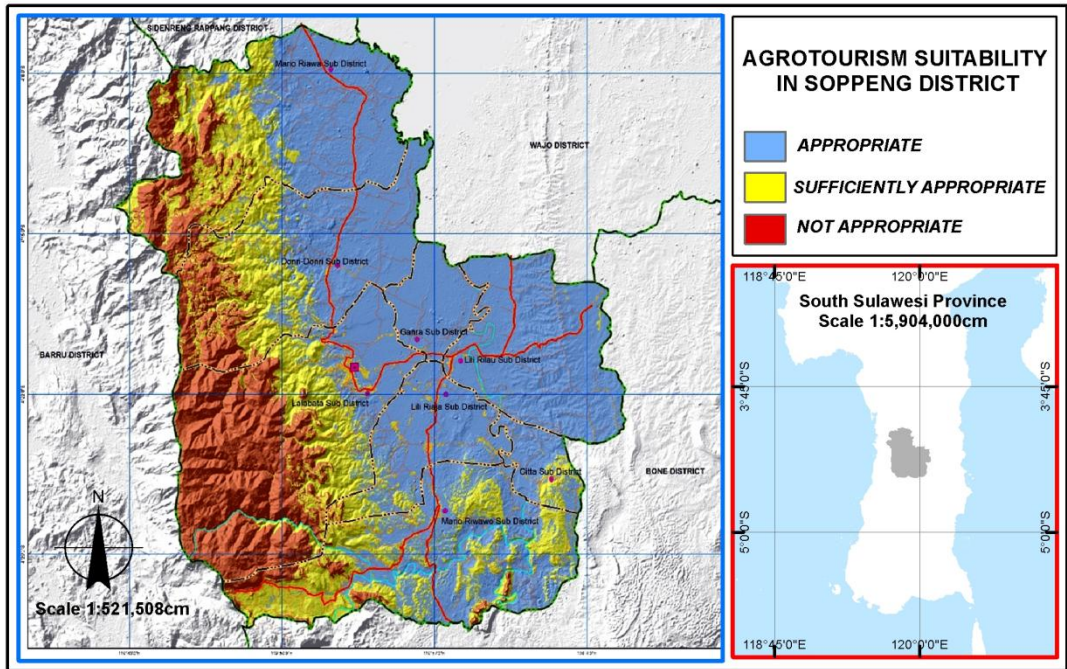

Figure 5. Agro-tourism land suitability map in Soppeng district

Identification of land suitability for agro-tourism is carried out to find out whether each area in Soppeng Regency has the potential for agrotourism development and to find out the various problems that exist. This is very important to study because, in general, the land contained in the agrotourism area includes natural resources that have a lot of potential and benefits to accommodate the socio-economic activities of the community in maximizing the environment. The current rural environment is more likely to develop towards educational tourism. This is good so that the general public can know the life and activities of farmers and create a positive image of agriculture for the next generation (Petroman *et al.*, 2016). Thus, the results of this education can add to the public's knowledge about marketing strategies for agricultural products, of course, with the government and the community (Liang *et al.*, 2020).

The results of the suitability for agrotourism areas based on the slope show beautiful views, especially towards the hills, which provide more visual value to attract the attention of visitors. The area of Soppeng Regency, especially in sloping to steep areas and close to resident villages, has a great opportunity to develop development and cultivation activities related to agrotourism (Gunarto, 2017). At the same time, the steep area is very important to pay attention to because this area is very prone to erosion to landslides which can endanger site users because currently there have been many minor damages due to soil erosion caused by land degradation (Huang et al., 2016). Therefore, planting plants in mountainous areas with steep slopes will provide stability to the slopes that can withstand soil movement if erosion occurs (Grima *et al.*, 2020).

Figure 6. Some objects in Soppeng that can be developed into agrotourism

Objects that have the highest value are the location of rice fields, peanut plantations, and farms. The three object locations are located in areas suitable for agro-tourism planning. The location of the object has the condition of agro-agricultural tourism attractions and the accessibility to the location is fairly easy and is located around the main road. The object in the agro-tourism planning area that has the lowest value is the cashew plantation. Various agricultural activities are very minimal and there are only cashew plantations associated with residential areas, so it is very difficult to enjoy the natural scenery of the cashew plantations. Meanwhile, the accessibility to the location is very easy and the road conditions are smooth and paved.

Most of the objects from plantations, agriculture to livestock that have agro-tourism potential in Soppeng Regency have been equipped with various natural scenery and supporting accessibility, but in terms of the availability of tourism resources, there is still a need for improvement and performance from various parties for the convenience of visitors who travel. If these four factors have been met, the objects in the agro-tourism planning area will be formed and become one of the recommended tourist sites.

Determination of agrotourism areas is not only based on the slope. But also in terms of soil type. The results of the identification of the area's suitability found that the soil types scattered in Soppeng Regency are quite good for use as an agrotourism area because this area has good fertility and humidity levels, especially in lowland areas. The relationship between soil type and agrotourism is closely related, where soil type is the main factor of soil fertility whose function is vital for plant growth, but highland areas will usually affect soil fertility due to different agricultural management practices, regardless of soil type (Tran et al., 2021).

The results of Landsat 8 image analysis in 2019 Soppeng Regency has agro-tourism potential seen from land use. In general, it consists of forests, mixed gardens, fields, plantations, settlements, rice fields, shrubs, and bodies of water. The potential of this land is very likely to become an agrotourism attraction even though it has not been fully utilized optimally. Therefore, it is necessary to assess the suitability of appropriate land use and implement policies by the government and involve every stakeholder in order to be able to reach the right decision-making for the sustainability of agricultural tourism (Lazoglou & Angelides, 2020).

Although land use has a great opportunity as a determinant aspect of agrotourism, if its management is not regulated in such a way, it will not get maximum results. For this reason, this research can be used as a reference so that land use in Soppeng Regency can be more focused so that land use management can be cultivated and carried out optimally in order to preserve the

environment, of course with the cooperation of the community and the government as the core of environmental management (Musavengane, 2019).

In addition to slopes, soil types, and land use, hydrological factors also influence soil and plant moisture as the basic things that support human life and development (Zhou & Wang, 2019). These factors will certainly greatly affect the productivity level of the agro-tourism area because the location of Soppeng Regency is also located along the watershed so that it has the potential to irrigate the soil and crops around it (Soppeng Regency Government, 2017).

Land suitability for agro-tourism planning in Soppeng Regency resulted in 5 suitability classifications. A very suitable area stretches from the north which borders Sidenreng Rappang Regency, towards the northeast which borders Wajo Regency to the east which borders Bone Regency. Meanwhile, the appropriate area is located in the mid-administrative area of Soppeng Regency and a small part of the suitability area borders Wajo Regency and Bone Regency. While the area is quite suitable, it is also in the middle of the administration of Soppeng Regency and is bordered by Bone Regency in the south. On the other hand, the unsuitable area for agro-tourism stretches from the northwest of Soppeng Regency which borders Sidenreng Rappang Regency to parts of Barru Regency and Bone Regency, while the area that is not very suitable for agrotourism is found in a fairly steep mountainous area in the southwest of Soppeng Regency. which also borders Barru Regency.

In general, Soppeng Regency has the potential for agro-tourism development based on the analysis results using the Overlay technique that combines each of the parameters used, namely soil type, land use, etc, and slope. Furthermore, a land suitability map was made for agrotourism areas in Soppeng Regency. The overlay results produce a composite map and divide the area into three land suitability areas, namely suitable, moderately suitable, and inappropriate areas. So that in essence Soppeng Regency is suitable for agro-tourism development.

The results of the analysis can be used as an agrotourism development plan in accordance with the current conditions and development of the village. Rural tourism can contribute to the development of agro-tourism that is tailored to the objectives of sustainable regional development and contributes to cultural, economic, and social development (Kastenholz et al., 2018).

Theoretically, the development of agrotourism certainly requires tourist attractions, both natural and artificial. For the development of agrotourism in Soppeng Regency, tourist attraction aspects already exist, consisting of agricultural land, natural scenery accompanied by biodiversity. The diversity of flora and fauna has the economic potential to be marketed as a promising agro-tourism attraction (Navarro-Martínez et al., 2020). However, these tourism potentials require maintenance that pays attention to sustainable and culturally valuable ecosystems (Chen, 2020).

Efforts to develop agrotourism in Soppeng Regency take several policies which will later be used as a guide in implementing agrotourism. The designation of agrotourism areas has been determined which is located in Mariolau Village and Gattareng Village in Marioriwawo District (Soppeng Regency Government, 2012). Based on the physical analysis of the land in this study, the location is in reasonably good criteria because it needs several conditions in developing agrotourism areas because it is located in a varied topography. But these limiting factors can be addressed by planting conservation plants that can prevent landslides and managing agricultural land that pays attention to environmental aspects. This limiting factor also requires cooperation from various parties so that in the future, there will be no overlapping interests that can damage the development of agrotourism areas in Soppeng Regency.

4. Conclusion

Soppeng Regency, South Sulawesi province, Indonesia has a natural beauty in the form of a mountainous area and many agricultural crop commodities, which are quite abundant, making this area have agrotourism potentials that are feasible to be developed. Based on the results of data

analysis using the overlay technique, it shows that suitable criteria for agrotourism areas dominate Soppeng Regency in general. However, in identifying the suitability of agro-tourism in this research, it is still not perfect due to the limitations of the data analysis used. Therefore, for similar research in the future, it will be able to identify the suitability of agrotourism viewed from various factors (physical, biophysical, social, and economic) and, most importantly, reach the stage of planning the agrotourism landscape.

Acknowledgement

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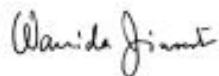
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The Utilization of Geographic Information Systems (GIS) for the Suitability of Agro-tourism Land

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Abstract

Development of environmentally friendly tourism can be interpreted as development that does not damage the environment and uses land wisely. In terms, agrotourism is a tourism activity that explore and utilize the potential of the environment in it as a tourist attraction. This study aims to determine the agrotourism area by the physical conditions of the environment in Soppeng Regency, South Sulawesi, Indonesia. Determining the suitability of agrotourism areas using quantitative descriptive methods using overlay analysis techniques or stacking parameter maps (land use, soil type, and slope) that have been scored and weighted beforehand using the Arcgis 10.8 application. The results of the overlay produce a composite map and divide the area into three classifications, namely areas that are suitable, quite suitable, and not suitable. The suitable area is 72794 Ha (53.52%), the suitable area is 34726.96 Ha (25.61%) and the unsuitable area is 28269.02 Ha (20.87%). Based on the results of the analysis of several parameters above, it shows that Soppeng Regency has the potential to be used as an agrotourism area which is also supported by the various types of agricultural activities in Soppeng Regency.

Keywords: Land Suitability; Geographic Information System (GIS); Land Suitability; Agrotourism

1. Introduction

The development of the tourism industry without paying attention to environmental impacts will certainly harm humans themselves. Therefore, environmental development needs to be developed not to damage the environment and provide knowledge to the wider community (Díez-Gutiérrez and Babri, 2020). The greater public knowledge about the environment, the better the impact will be felt (Gautam, 2020). This is because tourism can be a threat in the form of conservation area expansion that can damage protected ecosystems to disrupt the sustainability of tourism potentials (Canteiro *et al.,* 2018).

Indonesia's diversity of tourism potential includes natural resource-based tourism, including rural and agricultural landscapes where tourism has its charm as a destination that can provoke an increase and turn the wheels of the economy, especially for the government and society (Situmorang *et al.,* 2019). Rural tourism has now developed following the times where the main focus is locations that are the main icons of natural scenery, agricultural land, and culture (Xiang *et al.,* 2020). In simple terms, agrotourism is a tourism activity that utilizes the capabilities of agricultural land, processing production processes, and distributing production

products in which there are activities to introduce the rural culture and preserve the environment (Kaswanto, 2015).

Various previous studies raised almost the same theme, namely agrotourism – traditional knowledge and rural biotechnology (Ciolac *et al.,* 2015) and Agrotourism as prospects, interests, goals, and challenges in Nepal (Khanal and Shrestha, 2019). Meanwhile, in Soppeng regency, there was a study about the agrotourism to study and to analyze the potential and attractiveness of natural tourism in the Bulu Dua area and formulated a community-based nature tourism management strategy in the Bulu Dua area, Soppeng Regency (Muhammad and Darmawan, 2019). Diez-Gutierrez and Babri (2020) studied the development of tourism that can harm the environment. One of the factors causing increased pollution around tourist attractions comes from tourist behavior. One way to provide information to tourists is by determining the right tourist route. This study concludes that policymakers should consider improving the transportation system.

Canteiro *et al.* (2018) revealed that the threat of environmental expansion would impact the tourism sector. This study uses the Tourism Impact Assessment (TIA) method by evaluating the environmental impacts associated with nature conservation areas. The result is that fifteen tourism activities affect four biological components (biodiversity, land cover, soil, and water).

Xiang *et al.* (2020) stated that rural eco-tourism focuses on development by utilizing natural resources. Determination of standards using survey and evaluation methods in determining rural eco-tourism. This study uses the Decision Alternative Ratio Evaluation System (DARE) and the Delphi method. The research results in this scientific research show that natural conditions and the human condition are the core elements of rural eco-tourism resources.

Kaswanto (2015) studied the evaluation of agro-tourism based on four aspects, namely agriculture, tourism, beauty, and amenities (ATBA). That is, the development of natural tourism focuses on agriculture that is right for tourism. Spatial distribution of land use using Landsat image. Spatial distribution of land use using Landsat imagery. The spatial approach is used by combining the element values of each landscape. This study aims to design a land management scenario for agro-tourism using the ATBA method. At the same time, Chen (2020) discusses the environmental impacts caused by changes in environmental ecosystems. The method used to determine environmental changes using (ESV) is to assess each ecosystem.

Exploring the potential of agrotourism in Soppeng Regency, South Sulawesi province, Indonesia has been explained about the intensity of spatial use aimed at planning and developing agrotourism areas and integrating tourism activities to support the preservation of technically irrigated agricultural land (Soppeng Regency Government, 2012). Some of the objects in Soppeng that can be identified as an agricultural site such as rice fields, corn plantation, cocoa plantation, mango plantation, cashew plantation, dragon fruit plantation, watermelon plantation, peanut plantation, livestock farms, and cocoa seedling sites. This has become one of the drivers of research on agrotourism development in the Soppeng Regency. Thus, the potential for agricultural tourism, nature conservation, and culture can be maintained to preserve nature and culture as a gift from God Almighty. It is an effort to promote general welfare for the community through the development of village tourism potential by utilizing the potential of the environment and land for the benefit of tourist attractions for the welfare of the local community (Soppeng Regency Government, 2019).

In this research, the researchers intend to present information about the use of geographic information systems (GIS) to identify the suitability of agrotourism in Soppeng Regency, which is viewed from the physical aspect of the environment using the Overlay analysis technique (overlapping parameter maps) with the scoring and weighting method using the application. Arcgis 10.8.

2. Materials and Methods

The type of research used in this research is descriptive quantitative research.

Quantitative descriptive research is a research method based on the philosophy of positivism or a perspective when understanding a fact-based on empirical data, where data analysis is more statistical (Creswell and Creswell, 2017). Quantitative descriptive research is also a conscious and systematic effort to provide answers to a problem and or obtain more in-depth and broad-based information on an incident phenomenon using the stages of a quantitative approach. Moreover, the land use data that derived from Landsat, it needs to be validated through confusion matrix. Based on the ground check and the matrix analysis, the error percentage is 15%. Hence, the land use data can be used for further analysis.

2.1 Research sites

Soppeng Regency is located in South Sulawesi Province. It is divided into 8 sub-districts: Marioriwawo District, Lalabata District, Liliriaja District, Ganra District, Citta District, Lilirilau Donri-Donri District, and Marioriawa District. Marioriawa District is the largest sub-district, with an area of 320 km² or about 21.3% of the total area of Soppeng Regency. Meanwhile, the Citta sub-district is the sub-district with the smallest area, which is only 40 km² or 2.7 percent of the total area of Soppeng Regency. Soppeng Regency is geographically located at coordinates 4 6'00" - 4 32'00" South Latitude and 119 47'18" - 120 06'13" East Longitude as shown in Figure 1 below.

Soppeng Regency is surrounded by a vast mountainous landscape and a topography that varies from flat to steep with natural characteristics typical of the countryside. The research location has various agricultural and plantation resources and natural and artificial landscapes that have high enough potential to be used as agro-tourism objects.

Table 1. Types and sources of research data

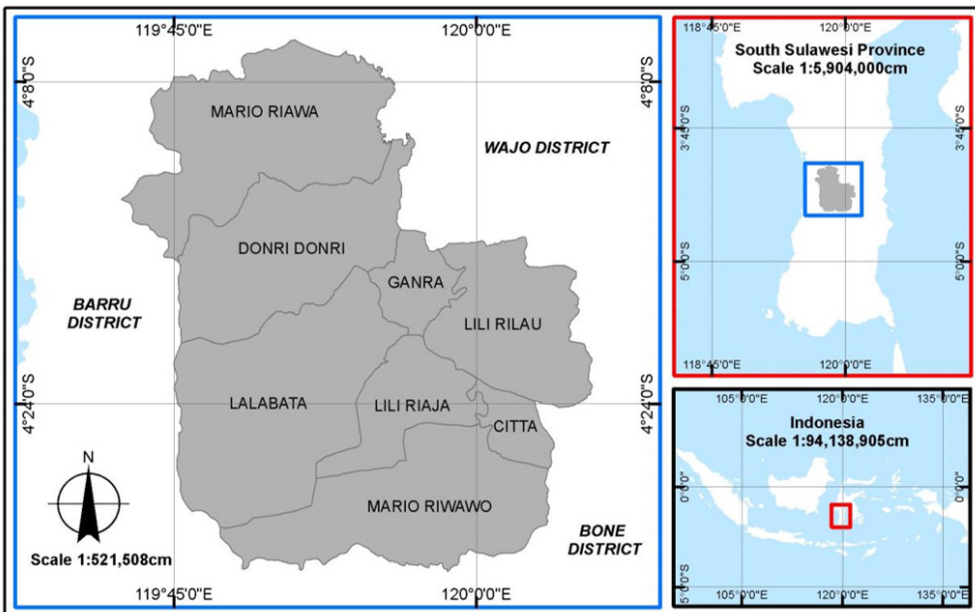| No	Data	Data Type	Data Source
1	Administration Map	Primary Data	Related Agencies
2	Slope	Secondary Data	Observation and Dem Srtm
3	Type Of Soil	Secondary Data	Related Agencies
4	Land Use	Primary Data	Landsat 8 Image Of 2019

Figure 1. Research location map

2.2 Agro-tourism Land Suitability Zone Analysis

In the context of tourism areas, planning is a systematic tool used to determine the initial moment of a situation and the best way to achieve it. Regional planning is carried out through several approaches, one of which is the natural resource approach, namely character determination and alternative recreation and tourism activities based on the results of monitoring the conditions and condition of the resources. In assessing physical conditions, land use, slope, and soil type can be important indicators in accordance with the recommendations of several experts and existing regulations.

Spatial analysis uses ArcGIS 10.8 software and overlay technique or parameter stacking after determining each criterion and scoring (Table 2 and Table 3). The spatial method is based on the slope, land use, and erosion sensitivity according to soil type.

Based on the assessment criteria and the score for the suitability of the recreation space above, a land suitability map for the designation of agrotourism areas in Soppeng

was compiled. The determination of the classification level is as follows:

$$\text{Classification of Potential Levels} \frac{\text{N Maximum} - \text{N Minimum Scores}}{\text{N Classification Levels}}$$

From the calculation of the scores for each parameter, the criteria for the suitability class were obtained. The results of the assessment of tourist areas are clarified as A (Appropriate), SA (Sufficiently Appropriate), and NA (Not Appropriate)

3. Results and Discussion

3.1 Analysis of the level of suitability of recreation space based on the slope of the slope

Slope data obtained from DEM SRTM 30 meters resolution. The results showed that the area that is suitable to be used as an agrotourism area has an area of 84429.42 Ha (61.91%), while the area that is not suitable has an area of 13099.35 Ha (9.61%) of the total area of Soppeng Regency. The results of the analysis can be seen in Table 4. The distribution can be seen in Figure 2, which generally shows the appropriate criteria.

Table 2. Assessment criteria and a recreational room suitability score

Aspects	Standards of Conformity	Criteria	Score
Land Use	There is no building structure and other vegetation other than the ground cover. The site is dominated by open land use.	fits	3
	The site is still quite dominated by open land use, but there are several structures and buildings and vegetation other than the ground cover.	Sufficiently Suitable	2
	Dominant site with Incompatible building	not suitable	1
Slope	0-8 % (Flat and Sloping)	Appropriate	3
	8-15 % (Slightly Steep)	Fairly Appropriate	2
	>15 % (Steep and Steep)	not suitable	1

*good = 3, moderate = 2, bad = 1, Source: (Hardjowigeno, 2007)

Table 3. Assessment criteria and conformity score sensitivity to erosion

Aspects	Standards of Conformity	Criteria	Score
Soil Type	Alluvial, Glei Planosol Hydromorphic Gray Soil, Literita Groundwater, Suitable Latosol	Suitable Latosol (Not Erosion Sensitive)	3
	Brown Forest Soil, Non Calcis Brown, Mediteran, Andosol, Laterit, grumosol, podsol, podsolik	Sufficiently (Sensitive erosion)	2
	Regosol, Litosol, organosol, renzina	Incompatible (Sensitive erosion)	1

*good = 3, moderate = 2, bad = 1, Source: (Ministry of Agriculture, 1980)

Table 4. Level of suitability based on slope

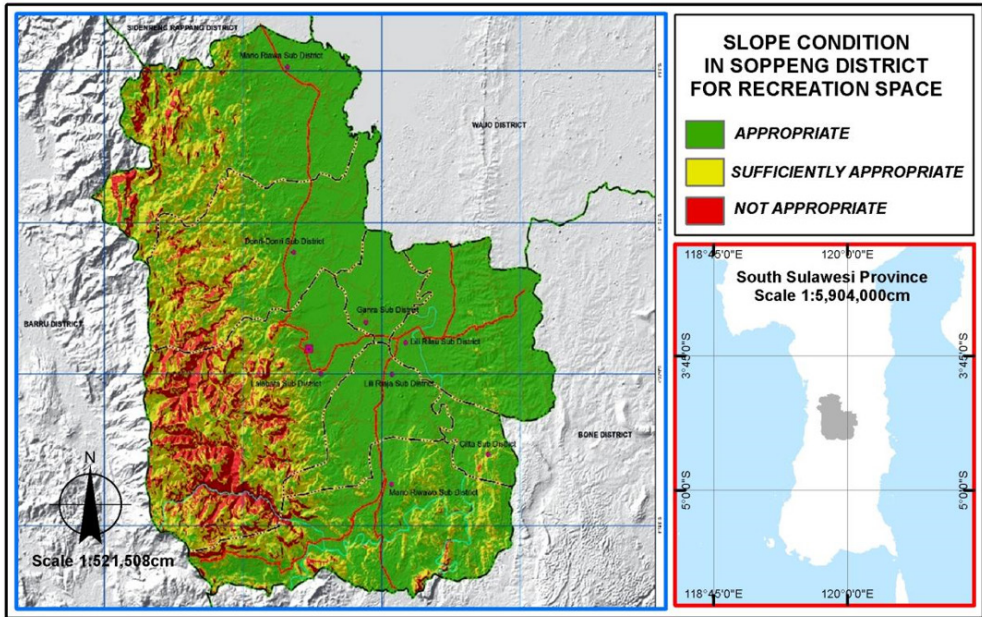| No	Classification	Slope (%)	Large	
			(Ha)	**(%)**
1	Appropriate	0 - 8	84429.42	61.91
2	Sufficiently Appropriate	> 8 - 15	38838.08	28.48
3	Not Appropriate	> 15	13099.35	9.61
	Total		136366	100

Source: Analysis results, 2021

Figure 2. Suitability map of recreation space based on slope

3.2 Analysis of the level of suitability of recreation space based on soil type

Determination of recreation space based on soil type is used as one of the main parameters. Where the results of the analysis show that the classification is quite suitable, having the largest area, which is 106639.46 Ha (78.2%) and the unsuitable classification has the smallest area of 1415.2 (1.03%). More details can be seen in Table 5 and its spatial distribution in Figure. 3, where a fairly adequate classification dominates the level of suitability of the recreation space according to the gromusol and Mediterranean soil.

3.3 Analysis of the level of suitability of recreation space based on land use

Image interpretation was carried out using Landsat 8 image data in 2019. Where the results of the analysis of the suitability of recreation space based on land use, the classification was obtained according to the largest area of 96958.93 Ha (71.1%), and the criteria did not match the smallest area of 4877.7 Ha (3.6%). More details can be seen in Table 6 and its spatial distribution in Figure 4. The level of suitability of recreational spaces is generally dominated by appropriate classification, so that in essence, Soppeng Regency has the potential to become a sustainable agro-tourism area.

Table 5. Level of suitability by soil type

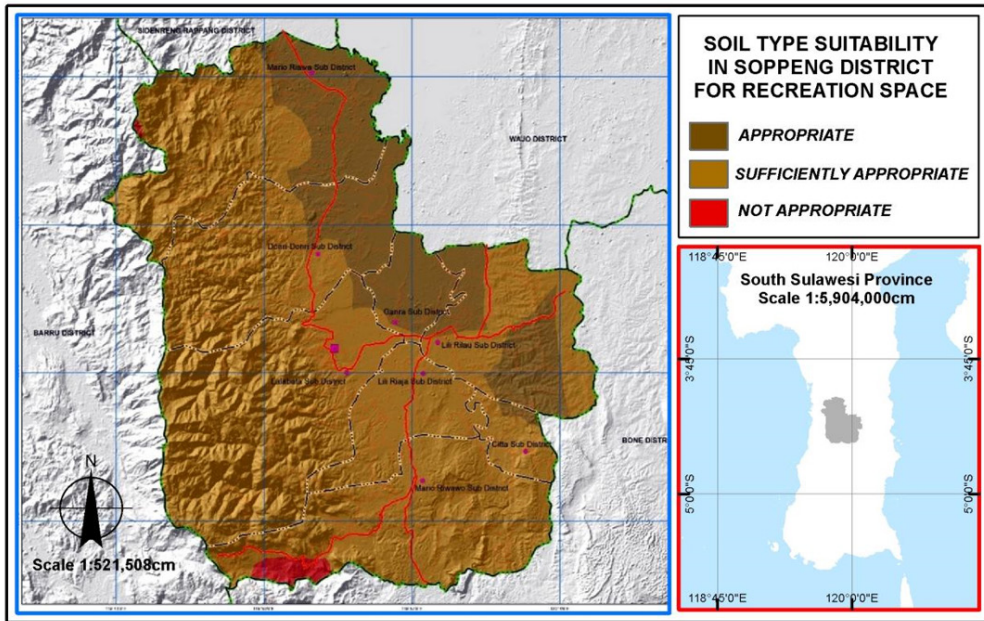| No	Classification	Type of Soil	Large	
			(Ha)	(%)
1	Appropriate	Aluvial	28311.79	20.76
2	Sufficiently Appropriate	Gromusol	17180.64	12.60
3		Mediteran	89458.82	65.60
4	Not Appropriate	Regosol	88.10	0.06
5		Litosol	1327.10	0.97
Total			136366	100

Source: Analysis results, 2021

Figure 3. Recreation space suitability map by soil type

Table 6. Level of suitability by land use

No	Classification	Landuse	Large	
			(Ha)	(%)
1	Appropriate	Field	10001.97	7.33
2		Garden	17409.58	12.77
3		Rice field	28564.92	20.95
4		Mixed garden	40982.46	30.05
5	Sufficiently Appropriate	Bushes and shrubs	1280.54	0.94
6		Forest	33219.63	24.36
7	Not Appropriate	Body of water	1430.45	1.05
8		Settlement	3477.25	2.55
Total			136366	100

Source: Analysis results, 2021

3.4 Analysis of Land Suitability for Agrotourism Areas

Based on the results of the overlay analysis using the Arcgis 10.8 application using the three indicators above, the results of the suitability of agrotourism land were obtained, which were divided into three

suitability zones, namely appropriate, quite suitable, and not suitable. The area suitable for agrotourism has the widest distribution, which is 72794.28 Ha (53.52%), and the unsuitable classification has the smallest area of 28269.02 Ha (20.87%). The results of the overlay analysis can be seen in Table 7.
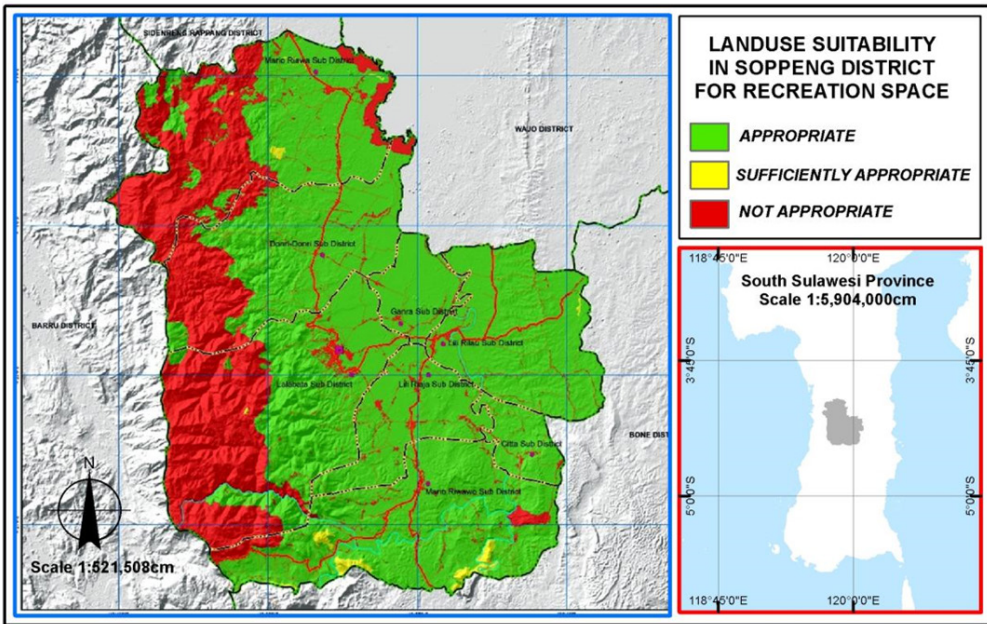
Figure 4. Recreation space suitability map by land use

Table 7. The wide distribution of overlayed agro-tourism areas

No	Classification	Large	
		(Ha)	(%)
1	Appropriate	72983.02	53.52
2	Sufficiently Appropriate	34918.65	25.61
3	Not Appropriate	28464.33	20.87
	Total	136366	100

Source: Analysis results, 2021

The identification of the spatial distribution of land suitability for agrotourism in the Soppeng Regency can be seen in Figure 5. In general, the Soppeng Regency area is dominated by area criteria suitable for agrotourism. Based on the results of the analysis and field observations, it is shown that the existing conditions in Soppeng Regency are suitable as an agro-tourism planning area. Given the abundant agro-tourism potential of Soppeng Regency, and currently has received attention from the district government, as evidenced by the existence of the Soppeng Regency Regional Regulation (Soppeng Regency Government, 2012).

Identification of land suitability for agro-tourism is carried out to find out whether each area in Soppeng Regency has the potential for agrotourism development and to find out the various problems that exist. This is very important to study because,

in general, the land contained in the agrotourism area includes natural resources that have a lot of potential and benefits to accommodate the socio-economic activities of the community in maximizing the environment. The current rural environment is more likely to develop towards educational tourism. This is good so that the general public can know the life and activities of farmers and create a positive image of agriculture for the next generation (Petroman *et al.,* 2016). Thus, the results of this education can add to the public's knowledge about marketing strategies for agricultural products, of course, with the government and the community (Liang *et al.,* 2020).

The results of the suitability for agrotourism areas based on the slope show beautiful views, especially towards the hills, which provide more visual value to attract the attention of visitors. The area of Soppeng Regency,

especially in sloping to steep areas and close to resident villages, has a great opportunity to develop development and cultivation activities related to agrotourism (Gunarto, 2017). At the same time, the steep area is very important to pay attention to because this area is very prone to erosion to landslides which can endanger site users because currently there have been many minor damages due to soil erosion caused by land degradation (Huang *et al.,* 2016). Therefore, planting plants in mountainous areas with steep slopes will provide stability to the slopes that can withstand soil movement if erosion occurs (Grima *et al.,* 2020).

Objects that have the highest value are the location of rice fields, peanut plantations, and farms. The three object locations are located in areas suitable for agro-tourism planning. The location of the object has the condition of agricultural tourism attractions and the accessibility to the location is fairly easy and is located around the main road. The object in the agro-tourism planning area that has the lowest value is the cashew plantation. Various agricultural activities are very minimal and there are only cashew plantations associated with residential areas, so it is very difficult to enjoy the natural scenery of the cashew plantations. Meanwhile, the accessibility to the location is very easy and the road conditions are smooth and paved.

Most of the objects from plantations, agriculture to livestock that have agro-tourism potential in Soppeng Regency have been equipped with various natural scenery and supporting accessibility, but in terms of the availability of tourism resources, there is still a need for improvement and performance from various parties for the convenience of visitors who travel. If these four factors have been met, the objects in the agro-tourism planning area will be formed and become one of the recommended tourist sites.

Determination of agrotourism areas is not only based on the slope. But also in terms of soil type. The results of the identification of the area's suitability found that the soil types scattered in Soppeng Regency are quite good for use as an agrotourism area because this area has good fertility and humidity levels, especially in lowland areas. The relationship between soil type and agrotourism is closely related, where soil type is the main factor of soil fertility whose function is vital for plant growth, but highland areas will usually affect soil fertility due to different agricultural management practices, regardless of soil type (Tran *et al.,* 2021).
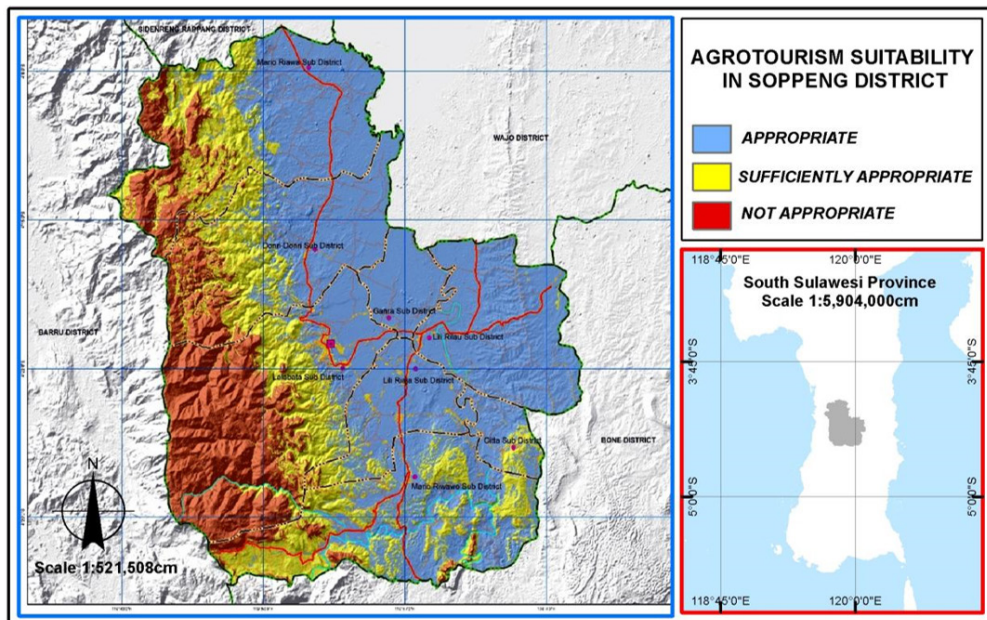

Figure 5. Agro-tourism land suitability map in Soppeng district

Figure 6. Some objects in Soppeng that can be developed into agrotourism

The results of Landsat 8 image analysis in 2019 Soppeng Regency has agro-tourism potential seen from land use. In general, it consists of forests, mixed gardens, fields, plantations, settlements, rice fields, shrubs, and bodies of water. The potential of this land is very likely to become an agrotourism attraction even though it has not been fully utilized optimally. Therefore, it is necessary to assess the suitability of appropriate land use and implement policies by the government and involve every stakeholder in order to be able to reach the right decision-making for the sustainability of agricultural tourism (Lazoglou & Angelides, 2020).

Although land use has a great opportunity as a determinant aspect of agrotourism, if its management is not regulated in such a way, it will not get maximum results. For this reason, this research can be used as a reference so that land use in Soppeng Regency can be more focused so that land use management can be cultivated and carried out optimally in order to preserve the environment, of course with the cooperation of the community and the government as the core of environmental management (Musavengane, 2019).

In addition to slopes, soil types, and land use, hydrological factors also influence soil and plant moisture as the basic things that support human life and development (Zhou & Wang, 2019). These factors will certainly greatly affect the productivity level of the agro-tourism area because the location of Soppeng Regency is also located along the watershed so that it has the potential to irrigate the soil and crops around it (Soppeng Regency Government, 2017).

Land suitability for agro-tourism planning in Soppeng Regency resulted in 5 suitability classifications. A very suitable area stretches from the north which borders Sidenreng Rappang Regency, towards the northeast which borders Wajo Regency to the east which borders Bone Regency. Meanwhile, the appropriate area is located in the mid-administrative area of Soppeng Regency and a small part of the suitability area borders Wajo Regency and Bone Regency. While the area is quite suitable, it is also in the middle of the administration of Soppeng Regency and is bordered by Bone Regency in the south. On the other hand, the unsuitable area for agro-tourism stretches from the northwest of Soppeng Regency which borders Sidenreng Rappang Regency to parts of Barru Regency and Bone Regency, while the area that is not very suitable for agrotourism is found in a fairly steep mountainous area in the southwest of Soppeng Regency. which also borders Barru Regency.

In general, Soppeng Regency has the potential for agro-tourism development based on the analysis results using the Overlay technique that combines each of the parameters used, namely soil type, land use, etc, and slope. Furthermore, a land suitability map was made for agrotourism areas in Soppeng Regency.

The overlay results produce a composite map and divide the area into three land suitability areas, namely suitable, moderately suitable, and inappropriate areas. So that in essence Soppeng Regency is suitable for agro-tourism development.

The results of the analysis can be used as an agrotourism development plan in accordance with the current conditions and development of the village. Rural tourism can contribute to the development of agro-tourism that is tailored to the objectives of sustainable regional development and contributes to cultural, economic, and social development (Kastenholz *et al.,* 2018).

Theoretically, the development of agrotourism certainly requires tourist attractions, both natural and artificial. For the development of agrotourism in Soppeng Regency, tourist attraction aspects already exist, consisting of agricultural land, natural scenery accompanied by biodiversity. The diversity of flora and fauna has the economic potential to be marketed as a promising agro-tourism attraction (Navarro-Martínez *et al.,* 2020). However, these tourism potentials require maintenance that pays attention to sustainable and culturally valuable ecosystems (Chen, 2020).

Efforts to develop agrotourism in Soppeng Regency take several policies which will later be used as a guide in implementing agrotourism. The designation of agrotourism areas has been determined which is located in Mariolau Village and Gattareng Village in Marioriwawo District (Soppeng Regency Government, 2012). Based on the physical analysis of the land in this study, the location is in reasonably good criteria because it needs several conditions in developing agrotourism areas because it is located in a varied topography. But these limiting factors can be addressed by planting conservation plants that can prevent landslides and managing agricultural land that pays attention to environmental aspects. This limiting factor also requires cooperation from various parties so that in the future, there will be no overlapping interests that can damage the development of agrotourism areas in Soppeng Regency.

4. Conclusion

Soppeng Regency, South Sulawesi province, Indonesia has a natural beauty in the form of a mountainous area and many agricultural crop commodities, which are quite abundant, making this area have agrotourism potentials that are feasible to be developed. Based on the results of data analysis using the overlay technique, it shows that suitable criteria for agrotourism areas dominate Soppeng Regency in general. However, in identifying the suitability of agro-tourism in this research, it is still not perfect due to the limitations of the data analysis used. Therefore, for similar research in the future, it will be able to identify the suitability of agrotourism viewed from various factors (physical, biophysical, social, and economic) and, most importantly, reach the stage of planning the agrotourism landscape.

Acknowledgement

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Thank you for the information. We've checked the galleys. The file is correct and suitable.

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