Planning ecotourism based on GIS in Gowa South Sulawesi

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Abstract. The main objective of this study is to identify and prioritize the potential ecotourism sites using Geographic Information System (GIS) in Distric Gowa South of Sulawesi. This study identifies the following factors as indicators of suitability within land ecosystems: landscape/naturalness, wildlife, topography, accessibility and community characteristics. The evaluating process for ecotourism site conducted based on eight chosen criteria including land use/cover, reservation/protection, species diversity, elevation, slope, proximity to cultural sites, distance from roads and settlement size. Those factors were selected according to the professional expert’s opinions. GIS plays a crucial role in ecotourism planning. Application GIS –Base proposed was useful to identify ecotourism sites by linking the criteria deemed important with the actual resources of Gowa District.

1. Introduction

The impact of land use change and land cover has been a hot topic for discussion since the mid-20th century, its global impact greatly influencing the goals of sustainable development. The influence of socio-economic factors, namely human activities related to land use such as forestry, agriculture and plantations is of particular concern to the dynamics of land cover and use and their interactions. Monitoring and evaluation of global impacts caused in particular the sustainability of results from natural resources has become a top priority for researchers in various fields and policy makers around the world.

The development trend of an area will always be different according to the characteristics of each region based on the dynamics of land use. The increase in population is one of the triggers for changes in land use caused by the need for land for survival. On the other hand the demand for the development of an area / region encourages the development of supporting facilities and infrastructure for the running of the government of an area, one of which includes the infrastructure of recreational areas in the nature tourism area [1].

Tourism activities have not the least negative impact on the environment. Increased intensity of human activity at tourist sites has an impact on disrupting the ecological process and triggering habitat fragmentation that threatens the survival of the biota (flora and fauna) in its natural habitat [2]. Other negative impacts can be seen from changes in vegetation structure, increased deforestation rates and reduced upstream to downstream water flow. The influence of visitor activity that sometimes clashes with local culture (local wisdom) also often occurs in tourist areas which triggers a shift in the cultural value of local communities.

However, that does not mean there is no way to keep activities in the tourism sector from a negative image. Because of the fact, tourism can still be empowering for the environment and local residents, if the implementation holds the principle of respecting local cultural wisdom and
environmental sustainability. To realize this, it is time for the concept of ecotourism to be applied to meet the needs of interest in traveling followed by the application of the concept of education based on environmental preservation in the tourist area.

Ecotourism has attracted increasing attention in recent years, not only as an alternative to mass tourism, but also as a means to promote the economic development and environmental preservation of a region. In accordance with the principles of ecotourism itself, namely how to minimize the negative impact on the environment and the preservation of local culture and maximize the economic benefits of local communities and the satisfaction obtained by visitors [3].

Reviewing the basic principles of ecotourism itself, namely how to engage visitors and local communities to foster understanding and reward environmental preservation by being directly involved in flora, fauna, geology and ecosystem conservation activities [4]. However, this relationship is not a necessity, but physical and biological aspects (landscape) are the main concern in ecotourism planning, development and management [5].

In analyzing ecotourism area planning is inseparable from the spatial elements as things that must be considered. Therefore, in analyzing problem conditions based on data from an area to be planned as an ecotourism location, spatial analysis can be used. The use of spatial analysis has been developed for location-based analysis using digital information that can be done with GIS (Geographic Information System). In addition, the use of GIS in ecotourism planning further ensures the accuracy of the data generated and is useful in planning natural resource conservation and responds to the problem of the realization of sustainable development [6].

Geographic Information Systems can be used as a supporting tool in making decisions for sustainable tourism planning, assessing the impact caused by tourism activities, managing visitor intensity, and choosing tourism locations. Therefore, the potential application of GIS in sustainable tourism planning is very important in helping to uncover the potential of natural resources, especially resources related to ecotourism development [7].

Gowa Regency is one of the regency in South Sulawesi that has a very rapid development in its area when viewed from the rate of change in land cover. There are many factors that influence the high rate of change in land cover including ecotourism activities and the construction of facilities and infrastructure around it [8] and specifically in Gowa Regency with the increasing number of tourist attractions is also not spared from the increased growth of land built in the form of supporting facilities from tourism site.

This study focused on biophysical studies in the Jeneberang I KPHP area with a spatial-based ecological landscape approach. Besides analyzing the linkages of several key factors of ecotourism such as the uniqueness of the landscape (natural attraction places), the existence of local communities (community culture) with the results can determine areas that are suitable for ecotourism.

2. Research Methodology
This research was conducted in FMU Jeneberang I Gowa Regency, South Sulawesi Province for 3 months starting in July 2019 - September 2019, which is located in an area that has become a tourist area and other potential areas that are suitable to be used as an ecotourism site. In this study using some data in the form of primary data and secondary data. Primary data is data obtained directly both through digital sources and in the field. Primary data includes: (1) DEM data (Digital Elevation Model) which is processed into height, slope and contour, and river data and (2) direct observations in the field regarding land use and the uniqueness of selected landscape based on accessibility and natural tourism areas that have potential attractions for ecotourism.

Secondary data are concerning the general condition of the research location obtained from literature studies along with data and other information that is directly or indirectly related to the study. Secondary data include spatial administrative data, Map of earth's appearance, soil type, spatial pattern, population data. A list of spatial data and sources is presented in table 1.
Table 1. List of secondary data requirements and sources

| No. | Title                                      | Source                                      |
|-----|--------------------------------------------|---------------------------------------------|
| 1.  | Administrative boundaries of Gowa Regency  | Makassar Forest Consolidation Center Region VII. |
| 2.  | DEM and Topographic Data                   | (earthexplorer.usgs.gov)                   |
| 3.  | Land cover in 2007 and 2018                | Makassar Forest Consolidation Center Region VII |
| 4.  | Map of the Distribution of Natural Tourism | Tourism Office of Kab. Gowa                 |
| 5.  | Road administration map                    | Gowa Station Meteorology, Climatology and Geophysics Agency or Global Weather |
| 6.  | Vegetation Density (NDVI)                  | (earthexplorer.usgs.gov)                   |
| 7.  | Population Data                            | Central Statistics Agency or the Civil Registry Office of Gowa Regency |
| 8.  | Regional Spatial Map                       | Spatial Planning for Gowa Regency           |

Figure 1. Geographical location of, Gowa Regency
Table 2. Factors and criteria in land suitability analysis for ecotourism

| Factor                      | Criteria                              | Unit                        | Factor Suitability Rating                      |
|-----------------------------|---------------------------------------|-----------------------------|-----------------------------------------------|
|                             |                                       |                             | High                           Moderate  | Marginal | Not suit |
| Landscape Naturalness       | Visibility Value range                | Near range                  | Middle range                       Far range | Not visible |
| Wildlife                    | Land use/ cover Class                 | High                        | Moderate                          Marginal | Not       |
|                             | Reservation/ Protection protected areas class | High | Moderate | Marginal | Not       |
| Species diversity           | % of recorded species                 | > 30%                       | 20-30%                           5-20 % | < 5%       |
| Topography                  | Elevation Meter                       | 300-400 m                   | 100-300 m                         > 400 m | 0-100 m   |
|                             | Slope Degree                          | 0-5°                        | 5-25 °                            25-35 ° | > 35 °    |
| Accessibility               | Proximity to cultural sites Kilometer | 0-15 km                     | 15-30 km                          30-45 km | > 45 km   |
| Community Characteristics    | Distance from roads Kilometer         | Areas outside of any 2 km   | Areas within 5 km buffer          | Areas within 10 km Urban settlements |
| Settlement size             | population size                       | Absence of permanent settlement | Unincorporated communities (1001-10000) |                      |

Figure 2. Overlay procedure used to identify potential ecotourism area
The procedure of this research is first by analyzing several determinants of landscape sustainability namely by using the criteria of landscape, slope, vegetation indices, accessibility, the existence of local communities and connectivity of locations. Then in determining the prospective ecotourism location, several criteria are used, namely: visibility, land use / land cover, conservation area, vegetation density, altitude, slope, cultural existence of the local community (local wisdom), accessibility, and population distributif. After all the above data has been analyzed, an overlay has been carried out to produce prospective ecotourism data in the form of polygon vector data, grouped into four sections, namely, Location is High suitable, suitable, moderately suitable and not suitable.

3. Result and Discussion

3.1. Ecotourism and Land Use Change in Gowa

In Gowa regency, the tourism industry is growing rapidly especially in two destinations which are internationally recognized (Appendix H). The tourism industry is frequently referenced in Gowa regency as a highly important stakeholder/user group with the potential to provide extensive benefits to the local government. However, recently, even though Gowa received 100,000 visitors only 2% of these were foreign while the rest were domestic visitors. The domestic visitors increased consequently and the impact of tourism increased rapidly due to environmental damages. Nevertheless, tourism is not as problematic compared to other factors of land use change in the study area. However, the rapid increase of visitors in Gowa can be considered a warning signal for tourism development in this region. Indeed, ecotourism planning is must needed for sustainable tourism development in this reserve natural resources especially ecosystem service which support sustainable ecotourism

![Ecotourism suitability maps for District Gowa](image)

**Figure 3.** Ecotourism suitability maps for District Gowa

3.2. Sustainable ecotourism in Gowa

Gowa Regency is one of the largest former maritime empires in Indonesia, its territory even reaches Madagascar. Cooperation and assistance provided to the kingdoms of Mataram and Sriwijaya, is evidence of the greatness of the kingdom of Gowa in his era. Gowa regency area is divided into 18
districts, 115 villages and 36 villages with an area of about 1,833.33 km². Most of the Gowa Regency is 80.17% and the lowland area is 19.83%. Sungguminasa, the capital of the Gowa Regency, is located in the Somba Opu sub-district, 10 km from the metro city of Makassar as the capital of the province of South Sulawesi. Because most of the area is a plateau, which is the reason it has the potential to become a tourist area as evidenced in Figure 2 above shows that more than 65% are included in the moderately suitable category.

In addition, based on Figure 2 it appears that there is a specific region that appears domina and falls into the category of highly suitable, i.e. tirta dam bili-bili tourism object. Dam bili-bili is located in the village of Bonto Parang, parang loe sub-district, about 25 km from the city of sungguminasa, the capital of the gowa district. The bili-bili dam was built as a multipurpose dam that functioned as agricultural irrigation and generating electricity. dam bili-bili also functions as a reliable tourist attraction in gowa district, with its beautiful panorama and available recreational facilities, visitors can enjoy special interest tours, for example fishing and other water sports. In this place we can also be served traditional food in the form of grilled fish that can be enjoyed with the family.

Other suitable tourism objects in Gowa Regency are located in Parangloe Subdistrict (according to Figure 2 in the suitable category, north of the Gowa Regency area) especially in Parangloe Waterfall, Borisallo Special Purpose Forest Zone (KHDTK) belonging to the Ministry of Research and Development Ministry of Environment and Forestry, Parangloe tourism park and the presence of Industrial Plantation Forest company PT. Inhutani I Gowa. What is interesting and unique with PT. Inhutani Gowa, which is close to several of these attractions, has its own special authority, especially giving lessons on how to manage the Forest Plantation sustainabe without disturbing the preservation of the surrounding natural resources.

4. Conclusion
1) The involvement of local people can be considered as a part of hospitality services in ecotourism industries in this region, because they can assist tourists according to their experience as guides in the forest. Moreover, they can be employed in the service industries operating or accompanying jungle boat trips and wilderness trails and assisting in transport operation. This study recommended that the local people should be involved in the planning process under participatory approaches which is refers, when decision makers prepare a plan, they must consider local people’s opinions and their interest.

2) Ecosystem protection will get first priority in ecotourism planning in the region especially the interests of local communities must be involved in planning, joint management in all responsible departments (Department of Tourism, Ministry of Environment and Forestry and Local Government).

3) Utilization of the ecotourism area will later attract investment and make national assets through a stakeholder empowerment program for the development of ecotourism and environmental preservation. In addition, land use is in accordance with the potential of ecotourism to increase economic contributions for managers and communities, as well as increase cross-sectoral coordination of the planning process, implementation and evaluation of ecotourism management.

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