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Biophysical study of green open space as a basis for ecotourism development in urban areas of Bulukumba Regency

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ABSTRACT

Rapid urbanization in Bulukumba Regency has reduced the area of green open space (RTH) due to uncontrolled land conversion. This study aims to analyze the potential, constraints, and strategies for developing green open space-based ecotourism in urban areas of Bulukumba Regency. The method used is descriptive with a qualitative and quantitative approach, through field surveys, spatial analysis using geographic information systems (GIS), and biophysical analysis of vegetation and fauna. Primary data were obtained from direct observation of the physical condition of green open space and biodiversity. The results show that public and private green open spaces have high ecotourism potential in terms of biodiversity and ecological functions, but face constraints in the form of limited infrastructure, accessibility, and lack of sustainable management. This study produces a biophysical and spatial-based ecotourism development strategy that can be used as a reference in sustainable city planning.

Keywords: green open space, ecotourism, development strategy.

INTRODUCTION

Green open space (RTH) is an important component in urban planning that plays a role in improving environmental quality, providing space for social activities, and maintaining the balance of ecosystems in urban areas. In Bulukumba Regency, Indonesia, the existence of green open space has great potential, especially with the rapid population growth and urbanization. This study aims to examine the potential of green open space in the Bulukumba urban area, with an emphasis on the management and utilization of available green open space.

Bulukumba, located in South Sulawesi, faces challenges in managing green open spaces due to increasing demand for land along with population growth. Based on the Regional Regulation on Regional Spatial Planning (RTRW), at least 30% of the total urban area must be allocated for green open spaces. However, the reality shows that the realization of this target is still not optimal, which triggers various environmental problems, such as flooding and declining air quality.

RTH is one of the important elements in urban spatial planning that functions as an area for environmental conservation, recreation, and a means of improving the quality of life of urban communities (Krisnawati, 2009). The existence of RTH in a city not only plays a role in ecosystem balance but also has great potential to be developed as a sustainable ecotourism destination. Research by Wardhani and Mayo (2020) shows that the use of RTH as ecotourism can increase the number of tourist visits while supporting conservation efforts.

Simangunsong (2016) specifically states that the form of RTH that needs to be accommodated

in urban areas functions as a balance between built-up and non-built-up areas in each block, both public and private RTH, as an area for playing, exercising, socializing, and various other activities that can be accessed by the entire community, functions such as various edaphic, orological, hydrological, climatological, protective, environmentally friendly, educational, and socio-economic functions, as a kind of strategy or whose use is limited to being used as a location for providing environmental facilities, infrastructure, and facilities, as well as an identity or characteristic of the environment.

The provision of RTH in urban areas is based on the area, with an ideal proportion of 30% of the total area: 20% for public RTH and 10% for private RTH. Public RTH is managed by the government and can be accessed by the public, while private RTH is owned by individuals or institutions. If the area of public and private RTH in a city exceeds the applicable provisions, it must be maintained.

The utilization of green open space is regulated in Law No. 26 of 2007 on Spatial Planning, with the aim of hydrological conservation, biodiversity development, microclimate creation, and pollution reduction in urban areas. Green open space also functions as a place of recreation, public cemetery, and urban development barrier, and has educational and socio-economic functions. Forms of green open space include play areas, sports, and provision of environmental facilities and amenities.

Rapid population growth in urban areas has triggered an increase in the need for RTH to balance built-up areas and provide ecological, aesthetic, and recreational functions for the community. The negative impacts of urban development such as reduced open land, increased air pollution, and decreased environmental quality, make green open space very important. Green open space functions to maintain the balance of the urban ecosystem and has the potential to become ecotourism, which is environmentally-based sustainable tourism. Identification of potential and constraints is the first step to meet the need for green open space. The potential for green open space includes city parks as recreational spaces, city forests for ecosystems, green open space yards as green areas that function as conservation and education facilities, green paths such as pedestrian corridors and road medians to support urban ecology, and agrotourism for educational tourism activities and sustainable agricultural tourism. Constraints such as land conversion for infrastructure development and organizations often reduce the percentage of green open space that has been fulfilled in urban areas, including Bulukumba Regency which is still below 30%. Lack of attention to facilities and lack of community participation are also inhibiting factors. After the potential and constraints are identified, an analysis of green open space needs is carried out including calculating land area, evaluating existing green open space conditions, and identifying potential ecotourism development zones.

The development of green open space-based ecotourism is expected to optimally utilize green open space as a recreation and education space, improve the quality of the environment in urban areas, support the regional economy, and maintain the ecosystems and ecological functions of green open spaces. This approach not only meets the needs of green open spaces, but also provides sustainable economic, social, and environmental benefits for urban communities.

Various studies that discuss the role of RTH in urban spatial planning and ecosystem conservation, studies that integratively combine biophysical and spatial approaches in the context of ecotourism development in urban areas, especially in small cities such as Bulukumba Regency, are still very limited. So far, the use of RTH as an ecotourism asset has not been supported by empirical data on vegetation characteristics, fauna diversity, ecological functions, and the availability of supporting infrastructure.

This study aims to fill the gap by conducting a comprehensive analysis of the biophysical potential of green open spaces, as well as spatial modeling based on GIS to formulate adaptive and sustainable ecotourism development strategies. Expected results include priority zoning of development based on ecological parameters, interpretation of satellite imagery, and physical attributes of the field that are operated directly.

The scientific contribution of this study lies in the formulation of a biophysical-spatial-based ecotourism development model that can be replicated in other urban areas in Indonesia and in developing countries with similar characteristics. Therefore, this study not only provides a new understanding of the integration of ecological potential and spatial planning, but also offers an evidence-based

approach in supporting the development of resilient and environmentally friendly cities.

RESEARCH METHODOLOGY

In this study, a descriptive method is used to describe systematically, factually, and accurately the existing conditions of green open spaces (RTH) in the urban area of Bulukumba Regency. The approach used is a combination of biophysical and ecological, which provides a comprehensive analytical framework for the aspects and geographical distribution of green open spaces. Biophysical Approach The biophysical approach includes a study of the biological and abiotic components of RTH. Data collection is carried out through:

- Vegetation sampling using the plot method:
- Tree: 20 × 20 m,
- Pole size: 10 × 10 m,
- Stake: 5 × 5 m,
- Seedling: 2 × 2 m.

Fauna observations used a 100-meter line transect method at each location, to record the presence of birds, insects and small mammals.

The observation data were analyzed using the important value index (INP) to identify dominant species, which was calculated using the formula:

$$INP = Relative\ Frequency\ (FR) + Relative\ Density\ (KR) + Relative\ Dominance\ (DR) \quad (1)$$

$$FR = (number\ of\ plots\ of\ species\ presence / total\ plots) \times 100 \quad (2)$$

$$KR = (number\ of\ individuals\ of\ species / number\ of\ individuals) \times 100 \quad (3)$$

$$DR = (basal\ cross\text{-}sectional\ area\ of\ species / total\ basal\ cross\text{-}sectional\ area) \times 100 \quad (4)$$

Vegetation analysis was conducted to determine the dominant species using the INP, while changes in land cover were traced through interpretation of Landsat 8 imagery.

Spatial Approach The spatial approach is applied using GIS to analyze land cover distribution patterns and changes:

- Secondary data in the form of Landsat 8 satellite imagery from 2013 and 2023 were used for land change analysis.
- Image processing was performed using QGIS software through land cover classification and visual interpretation techniques.
- Land use change is calculated based on the area of each cover category, such as forests, organizations, gardens, rice fields, and waters.

Biophysical and Spatial Integration The integration of these two approaches results in the identification of regional strategies that have high potential for the development of ecotourism based on inviting. The selection of locations is based on ecological indicators (biodiversity and INP) and spatial (land cover and regional connectivity), thus supporting adaptive and environmentally friendly city planning. The research will be conducted in Ujung Bulu District and Gantarang District, Bulukumba Regency, for 5 months, starting from August to December 2024.

The type of data in this study is primary data, namely data obtained directly from the first source obtained through direct observation in the field to assess physical conditions, vegetation, and fauna as well as the availability of supporting facilities. Vegetation data were collected using the plot sampling method with dimensions of 20 × 20 m (trees), 10 × 10 m (poles), 5 × 5 m (stakes), and 2 × 2 m (seedlings). Fauna data were obtained using the 100-meter transect line method at each location to observe the presence of birds, small mammals, and insects. Secondary data used include Landsat 8 satellite imagery, land use maps, and Bulukumba Regency RTRW documents, obtained from BPS, the PUPR Service, the Environmental Service, and other related agencies.

Data collection techniques consist of field surveys, to directly observe the condition of public and private green open spaces and geospatial mapping, to analyze the distribution of green open spaces, classification of land cover changes, and determine priority zoning for ecotourism development. Spatial data processing is carried out using QGIS software. Data analysis is carried out descriptively to describe the condition of green open spaces, and using biophysical and spatial approaches, such as (a) calculation of the INP of vegetation and fauna frequency as ecological indicators, (b) interpretation of land cover changes through Landsat imagery to determine the dynamics of space utilization, (c) document analysis to examine regional regulations, green open space management policies, and the direction of ecotourism development based on the environment.

RESULTS

Identification of potential and physical constraints of public green open spaces in urban areas of Bulukumba Regency

This study directly identifies the potential and constraints of public and private RTH in two subdistricts: Ujung Bulu and Gantarang, Bulukumba Regency. The results of the vegetation survey show that the tree species with the highest INP in urban forests are Trembesi (Samanea saman), with an INP of 132, followed by Angsana (Pterocarpus indicus) with an INP of 117, indicating strong ecological dominance.

For fauna, transect observations found that birds from the Passeridae family were most frequently found with a frequency of 68%, as well as the discovery of Sulawesi endemic species such as Celebesica abbotti, indicating high conservation value. These findings indicate that urban forests not only function as passive green spaces, but are also important habitats for local species.

On the spatial side, Landsat 8 image interpretation shows a decrease in forest cover of 1,573.93 ha in the last 10 years, while plantation land has increased by 819 ha, indicating land conversion pressure on potential ecotourism areas. Priority zoning for ecotourism development is compiled based on a combination of vegetation INP data, the presence of endemic species, and spatial accessibility, which are visualized in GIS maps.

In general, although supporting facilities are still limited, the diversity of vegetation and fauna and the spatial structure of green open spaces show great opportunities to be developed as locally-based sustainable ecotourism destinations.

RTH have great potential in the development of ecotourism, functioning as a place of recreation, relaxation, and a tourist attraction that supports the environment. Green open spaces offer opportunities to conserve biodiversity, increase environmental awareness, and provide economic benefits to local communities. Based on the inventory map, the research locations include city forests, city parks, and the Dato Tiro Islamic Center Park in Bulukumba Regency, which are marked with green circle captions in Figure 1.

The second image refers to the same area but in a different spatial resolution. The red line in image (1B) indicates the administrative boundaries of the sub-district, while the green circle marks the main observation locations analyzed in the study. Biophysical and Spatial Integration The integration of these two approaches resulted in the identification of regional strategies that have high potential for the development of ecotourism based on inviting. The selection of locations is based on ecological indicators (biodiversity and INP) and spatial indicators (land cover and regional connectivity), thus supporting adaptive and environmentally friendly city planning.

City forest

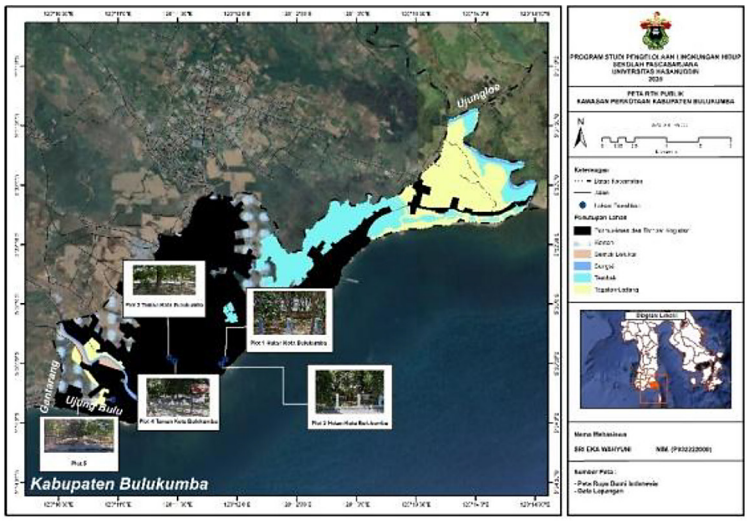
Ujung Bulu City Forest with an area of 4 hectares is a public green open space area. has high ecological and recreational functions. The results of vegetation analysis show that the dominant species at the tree level is Trembesi (*Samanea saman*) with an INP value of 132, followed by Angsana (Pterocarpus indicus) with an INP of 117. At the pole and sapling level, species such as Mengkudu (*Morinda citrifolia*) and Kudo (*Lannea coromandelica*) show quite high. This vegetation diversity reflects a good vertical stratification structure, supporting the function of carbon absorption and natural shade.

Fauna recorded using the line transect method include birds from the Passeridae family, such as sparrows and turtle doves, as well as the presence of *Celebesica abbotti,* a Sulawesi endemic bird that adds value to the conservation area. The highest fauna density is in areas with vegetation canopy cover > 70%.

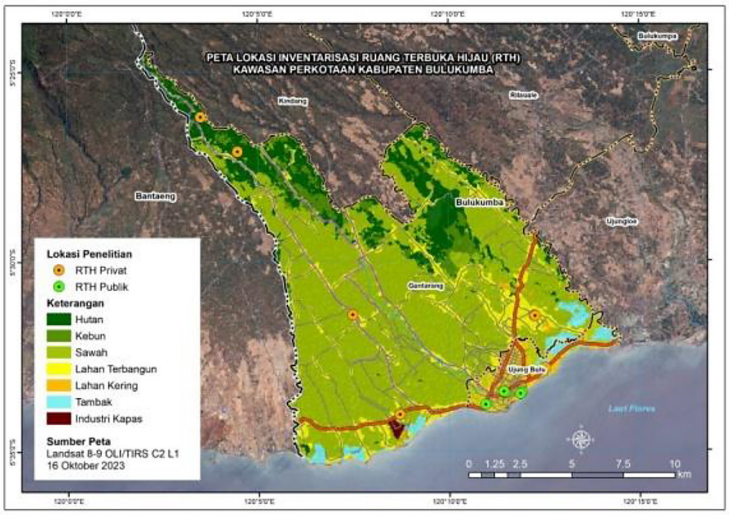
In terms of infrastructure, this area is equipped with pedestrian paths and seating, but most of the paths are damaged and poorly lit. The availability of trash bins is good, but the drainage system still needs to be improved. Accessibility is quite easy because it is located in the middle of the city, but there are no information boards or ecotourism education centers.

Spatially, this area is located in a zone that is still stable in terms of land cover based on Landsat 8 imagery, with little conversion pressure. Therefore, Ujung Bulu City Forest is identified as a high priority zone for the development of ecotourism based on conservation and environmental education.

Infrastructure development does not reduce green open space, with additional green open space being added every year. Facilities such as roads, parking areas, waste management, and



(1A)



(1B)

Figure 1. (1A) Map of the location of the initial observation points covering a wide area of Bulukumba Regency; (1B) Map of green open space inventory locations in the urban area of Bulukumba Regency

worship are adequate, but drainage and security need attention (Figure 2).

Bulukumba city park

Ujung Bulu City Park covering an area of 16.354 m² is a public green open space that functions as a sports area, recreation, and community activity center. Vegetation analysis shows that the dominant tree species are angsana (*Pterocarpus indicus*) and tanjung (*Mimusops elengi*), followed by glodokan tiang (*Polyalthia longifolia*) and mahogany (*Swietenia mahagoni*). The highest INP was recorded in Angsana, reflecting strong ecological dominance in the park structure. The pole and seedling levels are dominated by the same species, indicating the continuity of natural regeneration.

Observation of fauna through transects shows the dominance of *Passeridae* (sparrows), as well as the presence of endemic species of Sulawesi such as the Sulawesi Hornbill (*Aceros cassidix*) which has high conservation value. Fauna is more actively detected in areas with shady vegetation and far from vehicle routes.

Park facilities include walking paths, seating, trash bins, and sports areas. However, some walking paths are damaged and lighting is suboptimal. Parking areas are limited and some parts are used for street vendors, which can disrupt the ecological function of the park.

Spatially, this park is located in an area with high utilization intensity, but its land cover is relatively stable. This shows the importance of integrated management so that the ecological

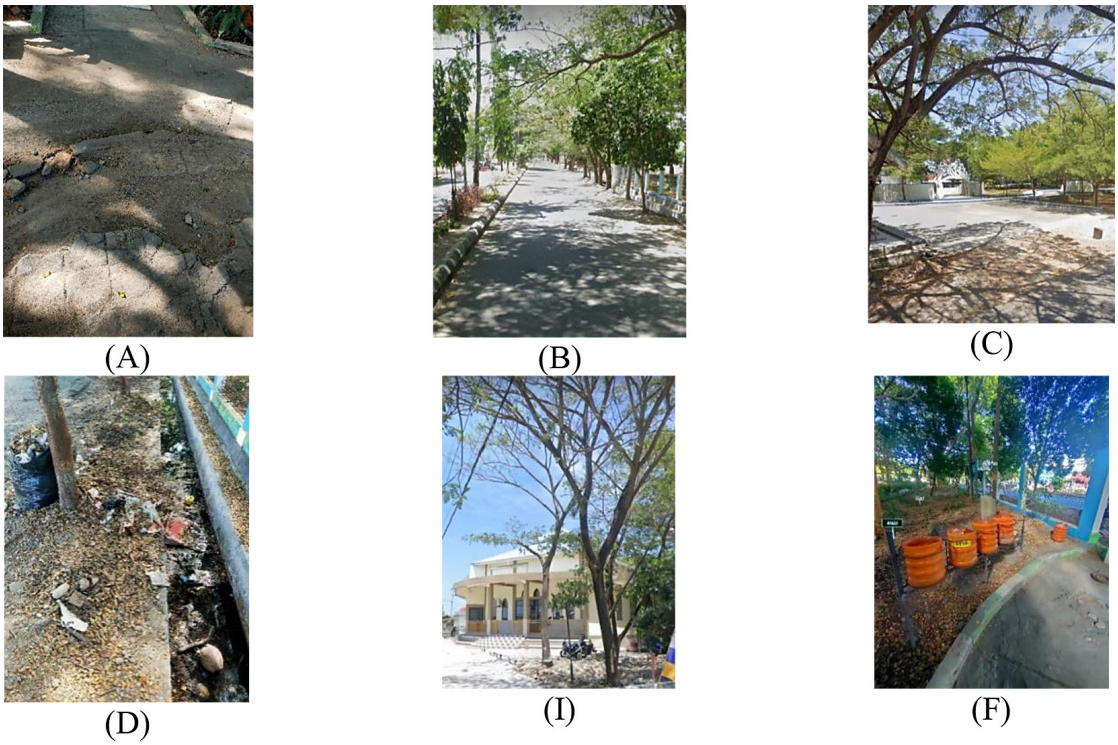


Figure 2. Physical conditions of the city forest (a) one-step path is not maintained; (b) asphalt network; (c) bicycle parking area; (d) drainage in the city park; (e) place of worship; (f) waste disposal area provided

and social functions of the park remain balanced. With varied vegetation and a strategic location, this park is worthy of being developed as an educational and recreational zone in the middle of the city (Figure 3).

Dato Tiro Islamic Center Adipura Park Bulukumba

Taman Adipura Islamic Center is a public green open space integrated with religious and social facilities in the center of Bulukumba City. Based on plot observations, the dominant species at the tree level is Samanea saman (*Trembesi*), while at the pole and stake level it is dominated by Mimusops elengi (*Tanjung*) and Cerbera manghas. The vertical diversity formed provides optimal protection and habitat for local fauna.

Through the line transect method, the fauna observed consisted of five species of birds, dominated by the Passeridae family, as well as the presence of the Sulawesi Hornbill, an endemic species that marks the conservation value of the park. Fauna activity was denser in areas with dense vegetation and far from commercial areas.

Park facilities include wide walking paths, ornamental gardens, religious monuments, parking areas, and good electricity networks. However, cleanliness is still a challenge due to limited trash bins. The drainage system works well in some areas, but there is puddles during heavy rain.

From a spatial aspect, the park is located in a rapidly developing urban center, but based on satellite imagery interpretation, its vegetation cover is relatively stable. Its strategic location, socio-religious function, and the presence of endemic species make this park very potential to be developed as a religious and educational ecotourism that supports local cultural values and environmental conservation (Figure 4).

Identification of potential and constraints of private green open space in urban areas of Bulukumba Regency

Research was also conducted in several private green open spaces, including the Mixed Gardens in Ujung Bulu and Gantarang, as well as yard institutions such as STIKES Panrita Husada and the DIKBUD office yard. These private green open spaces show heterogeneous vegetation structures and have the potential to support the development of community-based ecotourism.

This aims to identify and explore the potential and constraints of private RTH in supporting ecotourism development in urban areas of Bulukumba Regency. Focusing on private RTH is important

Figure 3. Physical condition of city parks (A) damaged sidewalks; (B) poorly maintained; (C) inadequate lighting; (D) trash bins; (E) street vendors; (F) gazebos

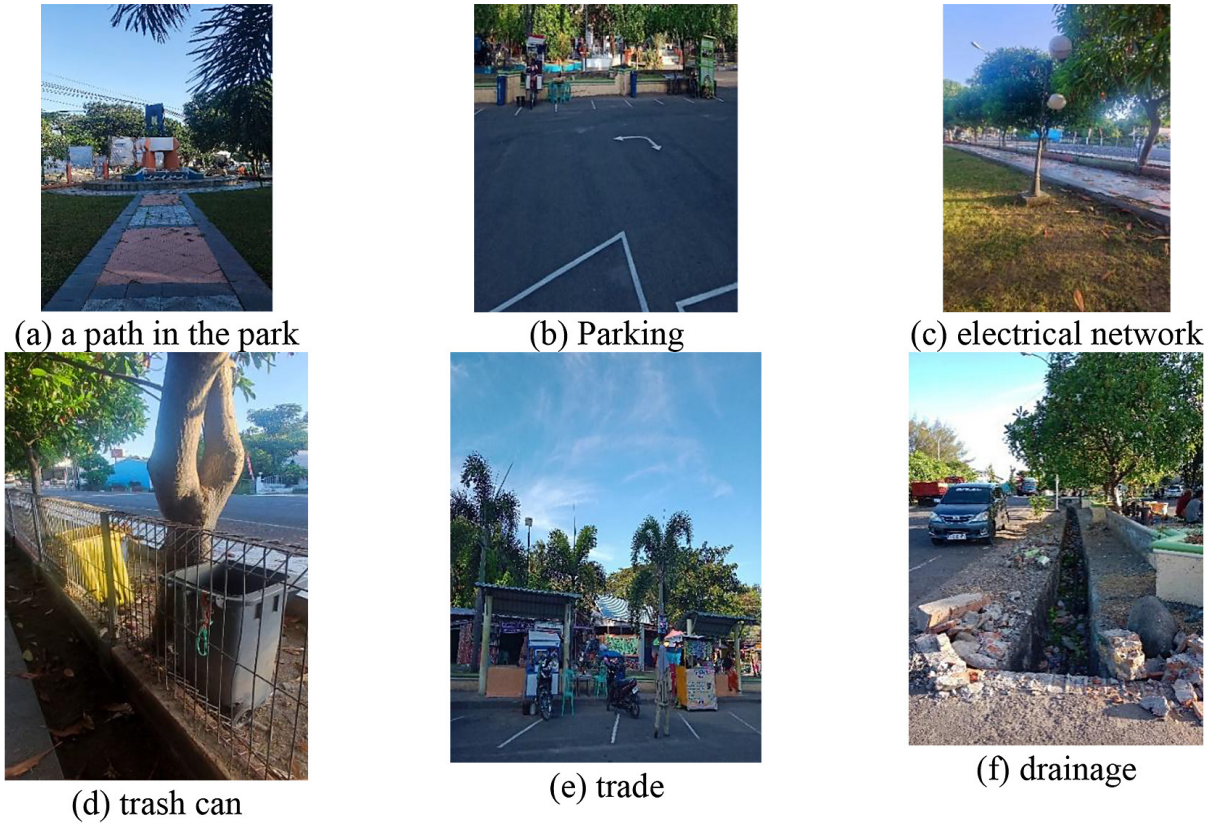


Figure 4. Physical condition of city parks: (a) roads in the park; (b) parking; (c) electricity network; (d) trash bins; (e) street vendors 5; (f) drainage

because this type of open space has a wide distribution in organizational and institutional areas, and has great potential in empowering local communities through a community-based ecotourism approach (*community-based ecotourism*). In addition, private RTH is often not recorded in official city planning, but actually stores significant biodiversity and ecological value

a) Location and type of private green open space

The research was conducted at five private green open space locations spread across Ujung Bulu District and Gantarang District, namely:

- Ela-Ela mixed garden.
- Dampang mixed garden.
- Gantarang mixed garden.
- Panrita Husada Yard Health College.
- DIKBUD Region V Branch.

Location selection is based on the criteria of land area above 750 m², vegetation diversity, accessibility, and participation of managers or owners in environmental conservation.

- Ela-Ela Mixed Garden (5.247 m²), the dominant species at the tree level is breadfruit (Artocarpus altilis), while the poles and seedlings are dominated by moringa (*Moringa oleifera*) and kudo (*Lannea coromandelica*). The existence of vegetation with high economic value opens up opportunities for the development of agrotourism. The fauna found consists of six types of insects and one reptile, with the highest concentration in shaded and densely vegetated areas.
- In Dampang Garden (4.028 m²), the dominant tree species are teak (*Tectona grandis*) and mahogany (*Swietenia mahagoni*), with the pole level dominated by cloves (*Syzygium aromaticum*). Observed fauna include sparrows and swifts. The main obstacles in this location are limited access, the lack of pedestrian paths, and the lack of public facilities.

Stikes Pekarangan Panrita Husada and Dikbud Bulukumba have high vegetation diversity, dominated by Trembesi, Angsana, and Mangga, as well as the presence of endemic birds and insects such as butterflies and grasshoppers. Facilities such as gazebos, sports fields, and prayer rooms support the socio-educational function of the area.

Spatially, these private green spaces are spread across densely populated to semi-urban areas. Although not all areas have high accessibility, the presence of natural vegetation and the involvement of local communities make private green spaces an important resource in participatory ecotourism strategies based on education and conservation.

Ela-Ela mixed garden

A mixed garden owned by residents in Ujung Bulu District covering an area of 5.247 m² became the location for private green open space research. The vegetation studied was based on the area of the plot: trees, poles, stakes, and seedlings. *Artocarpus artilis* (Sukun) dominated the flat tree, *Moringa oleifera* on the flat pole, *Lannea bunga koromadelica* (Kudo) at the stake level, and *Morinda citrifolia* and *Mangifera indica* at the seedling level. The identified fauna included 6 types of insects and one type of reptile. Obstacles to ecotourism development include poor accessibility, the absence of supporting facilities such as parking areas, footpaths, trash bins, public toilets, lighting, and other educational facilities. The lack

Figure 5. Map of Ela-Ela mixed garden

Figure 6. Map of Dampang mixed park

of infrastructure hinders the comfort and safety of visitors (Figure 5).

Dampang mixed garden

The 4.028 m² Dampang mixed garden in Gantarang District is the location for private green open space research (Figure 6). Vegetation studied in one plot is based on plot size: trees, poles, stakes, and seedlings. At the tree level, *Tectona grandis* (teak) has the highest INP value, followed by *Swietenia mahagoni* (mahogany) and *Syzygiumaromaticum* (clove). At the pole level, cloves dominate, followed by chili and teak. At the seedling level, *Moringa oleifera* dominates. Fauna research using the line transect method showed the highest density of Java Sparrows and Sparrows, while swifts, sparrows, and nectar birds had lower densities. Constraints in ecotourism development include the lack of facilities and infrastructure, such as hiking trails, parking areas, and information centers, as well as limited accessibility.

A mixed garden owned by residents in Ujung Bulu District with an area of 763 m² became the location for private green open space research. The vegetation studied in one plot was based on the classification of plot size: trees, poles, stakes, and seedlings. At the tree level, mahogany dominates the number of individuals and their distribution, while teak dominates the size and volume of the trees. At the pole level, cloves dominate with high density and dominance. At the stake and seedling levels, *Syzygiumaromaticum* and *Cocos nucifera* each dominate, although the diversity of vegetation is low. The fauna identified in this garden is relatively low, with three main types of fauna (insects and birds). Constraints in developing ecotourism include the lack of facilities such

Figure 7. Image map of Gantarang mixed park

as hiking trails, parking areas, rest areas, information centers, and limited accessibility (Figure 7).

Panrita Husada Health College

The yard of STIKES Panrita Husada, covering an area of 6.690 m² in Gantarang District, Bulukumba Regency, is a private RTH that is beautiful and functional as a habitat for local flora and fauna. This area supports research activities and the development of green concepts that are useful in academic activities and environmentally based ecotourism. The vegetation in this yard consists of various types of trees, poles, stakes, and seedlings, with the dominant tree types being trambesi (*Samanea saman*), angsana (*Pterocarpus indicus*) and mahogany (*Swietenia mahagoni*) at the pole level, and *Moringa oleifera* and *Mangifera indica* at the sapling and seedling levels. Fauna diversity includes endemic Sulawesi birds and domestic fauna. Facilities and infrastructure in the yard include a mosque, gazebo and sports field, which support spiritual, social, educational and physical activities in the development of ecotourism (Figure 8).

DIKBUD branch office area V Bulukumba regency

The DIKBUD Branch Yard of Region V Bulukumba Regency, covering an area of 4.893 m², is a private green open space that supports educational and government activities, with various shade and decorative vegetation. Vegetation is dominated by Glodokan Tiang and Trambesi, enriching the variety of ecosystem structures. The results of fauna research show the presence of endemic Sulawesi birds such as the Dwarf Sungu musk deer and Sulawesi mouse deer, as well as insects such as grasshoppers and butterflies. This yard has the potential as an educational green open space with easy access and a variety of vegetation that functions to maintain environmental balance. The main obstacles include limited facilities such as hiking trails, parking areas, and information centers (Figure 9).

Physical area potential through satellite image interpretation

The potential of urban area can be analyzed in depth through the interpretation of Landsat 8 satellite imagery, which provides an accurate picture of changes in land use. The land change map for the past 10 years shows the dynamics of the area. Based on the results of the interpretation of Landsat 8 satellite imagery, the area of urban areas in Bulukumba Regency (Ujung Bulu District and Gantarang District) remains stable at 16.849 ha from 2013 to 2023, despite changes in land use patterns (Table 1).

From the table above, there are two types of land cover in the urban area of Bulukumba Regency that experienced a decrease in area in 2013–2023, namely forests and dry land. Forests experienced a decrease of 1,573.93 ha, while the other four types of land cover experienced an increase, especially garden land with an additional area of 819 ha. The decrease in forest cover, which is important for ecotourism, can still be utilized with sustainable management for nature tourism and wildlife observation. The increase in rice fields and ponds shows the potential for agro- and aquaculture-based ecotourism. The addition of garden land opens up opportunities for fruit garden tourism and organic farming training. The decrease in dry land by 306 ha provides an opportunity for changing areas that are not productive

Figure 8. Map of STIKES Panrita yard husada

Figure 9. Map of Dikbud Branch office, Region V, Bulukumba Regency

Table 1. Change area of Bulukumba Regency city

Land cover	Code	Year 2013	Year 2023	Change
		Area (ha)	Area (ha)	Area (ha)
Forest	Tall	4143.75804	2569.8235	▼ 1,573,934,515
Garden	Kb	Number 0	Phone number 818.75094	▲ 818.750941
Dry land	LK	388.690568	82.563235	▼ 306.127333
Built-up land	English: MORE	Phone number 2008.268702	2731.804	▲ 723.535290
Ricefield	United Kingdom	9965.569928	10288.98	▲ 323.409794
River	English	35.111511	35.111511	▲ 0
Pool	Tmb	307,636 people	322.00182	▲ 14.365823
Total		16849.03476	16849.035	

enough into new green open spaces, such as ecological parks or city forests.

Social cultural potential of the community

The majority of the urban population of Bulukumba Regency is Bugis who use the Bugis language and respect the Siri' (shame) culture as the main way of life, teaching religious norms. This can be the basis for ecotourism that is environmentally friendly and respects local values, with interactive programs to teach the Siri' culture. Bulukumba is also known nationally and internationally through its traditional boat-making industry such as the pinisi, which can be an object of maritime culture-based ecotourism. In addition, traditional ceremonies such as Maccera Hewan and the characteristics of Bugis culture, such as food, traditional dance music and traditional houses, can be used as tourist attractions. The homestay program in traditional houses provides tourists with direct experience of local community life.

DISCUSSION

Potential and constraints of public green open space in urban areas of Bulukumba Regency

Public RTH plays an important role in maintaining the balance of urban ecology while providing a friendly environmental recreation space for the community. In addition to functioning as the lungs of the city, this area also holds the potential for biodiversity that can be utilized for the development of ecotourism. With proper management, public green open spaces can become educational

tourism destinations that support environmental conservation and increase public awareness of the importance of maintaining urban ecosystems. The following is a discussion of the potential for biodiversity in public green open spaces and their contribution to the development of ecotourism.

The potential for biodiversity for ecotourism development can include the following:

1. Unique flora and fauna – the existence of endemic flora and fauna is the main attraction in ecotourism. Protection and sustainable use can increase the attractiveness of the area for tourists.
2. Diverse ecosystem – diverse ecosystems such as forests, wetlands and desert grasslands allow for a variety of interesting nature tourism activities, such as trekking, bird watching and nature photography.
3. Environmental conservation – ecotourism provides an opportunity to support biodiversity conservation by allocating a portion of tourism revenue to environmental conservation.
4. Education and educational environment – ecotourism can be used to provide environmental education to tourists about the preservation of local flora and fauna.
5. Local community involvement – with high biodiversity potential, local communities can be involved as tour guides, ecotourism managers, and producers of environmentally friendly products.

Potential and constraints of private green open space in urban areas of Bulukumba Regency

The potential of biodiversity in RTH owned by residents, especially mixed gardens owned by residents, has significant value in the development of ecotourism. The existence of various types of flora and fauna in this area not only reflects the high ecological ecology but also provides opportunities for the community to utilize natural resources sustainably. The following is a discussion of the potential of biodiversity in the study location and its contribution in supporting the development of ecotourism based on the environment and the participation of the local community.

Vegetation diversity dominated by plants with high economic characteristics shows great potential for the development of agroforestry-based ecotourism. Activities that can be developed include:

- Educational tourism – Tourists can be given insight into the ecological cultivation of cloves, pepper and the benefits of teak trees.
- Introduction to agroforestry – education on the importance of mixed gardens in maintaining ecosystem balance.
- Conservation ecology – education about the importance of ecological conservation of teak trees and the benefits of mixed vegetation.
- Agricultural agrotourism – the existence of chickens and horses can be developed as an educational tourist attraction related to livestock in the country.

This study shows the importance of including private green open spaces into the city's spatial database and making them part of integrated ecotourism planning. Biophysical and spatial-based development must consider a participatory approach that places local communities as the main actors in the conservation and sustainable use of green spaces.

Main obstacles to developing private green space ecotourism

The main obstacles to developing ecotourism in private green open spaces include:

- Limited accessibility – many private lands are difficult to reach by public transportation.
- Lack of facilities and Infrastructure – there are no basic facilities for visitor comfort.
- Low formal participation – there is no institutional support or policy that integrates private green open spaces into regional tourism development plans.

CONCLUSIONS

Based on the research results, it can be concluded that RTH in Bulukumba Regency has great potential to be developed into an environmentally friendly ecotourism destination. City forests, city parks, and individual green open spaces have a diversity of flora and fauna that can be nature-based tourist attractions. However, the main obstacles in managing RTH are the lack of infrastructure maintenance, the lack of supporting facilities, and the low public awareness of the importance of RTH. In addition, changes in land cover due to conversion of function are a significant threat to the sustainability of green open space.

Based on the research results, it is recommended that improvements be made to the maintenance of green open space infrastructure and facilities, such as pedestrian paths, parking areas, and other public spaces, to support visitor comfort. In addition, it is necessary to hold educational and socialization programs for the community about the importance of green open spaces in order to increase ecological, social, and economic awareness. Strict supervision of land functions and law enforcement with clear sanctions are very important to ensure the sustainability of green open spaces. Collaboration is needed between the government, private sector, and local communities to support the development of green open space-based ecotourism, support through funds, promotion, and active community involvement in the maintenance and care of green open spaces.

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