

SUITABILITY AND PROJECTION OF LAND USE FOR GREEN OPEN SPACE IN GAMPONG TIBANG, DEAH RAYA AND ALUE NAGA SYIAH KUALA DISTRICT BANDA ACEH CITY

Dhea Asmaul Husna¹, Satia Negara Lubis², Agus Purwoko³

Sekolah Pascasarjana Perencanaan Pembangunan Wilayah dan Pedesaan Universitas Sumatera Utara^{1,2,3}

ARTICLE INFO

Keywords:

Car request,
GDP per capita, long way, fuel
price, consumer credit interest
rates

ABSTRACT

Green open space is an area that must be provided by a city, this is by the provisions in the Regulation of the Minister of Agrarian Affairs and Spatial Planning/Head of the National Land Agency of the Republic of Indonesia Number 14 of 2022 concerning the Provision and Utilization of Green Open Space Chapter II Typology of Green Open Space Article 3 at least 30% (thirty percent) of the area of the City or Urban Area consists of public green open space of at least 20% (twenty percent) and private green open space of at least 10% (ten percent). Based on the Banda Aceh City spatial pattern plan for 2009-2029, Gampong Tibang, Alue Naga and Deah Raya are areas prioritized for green open space development. These three Gampongs have an area of 596.2 Ha, including the Tibang area of 203.3 Ha, Deah Raya 102.4 Ha and Alue Naga 290.5 Ha (BIG). These three Gampongs are located on the coast of Banda Aceh City. This research aims to analyze the extent and distribution of green open space, analyze the suitability of land use for green open space and project the need for green open space in Gampong Tibang, Deah Raya and Alue Naga, Banda Aceh City in 2033-2043. The methods used are geographic information system analysis, logical suitability matrix, projected green open space needs and descriptive. The research results show that the Gampong Tibang GOS in 2023 will have an area of 36.7 ha, the Gampong Deah Raya GOS will have an area of 28.3 ha, and Gampong Alue Naga will have an area of 44.4 ha. The suitability of the use of green open space is not appropriate based on the area of green open space in the spatial pattern plan and the existing one, Gampong Tibang, the area of green open space planned for the spatial pattern is 88.6 ha while the existing is 36.7 ha, Gampong Deah Raya, the area of green open space planned for the spatial pattern is 84.2 ha while the existing is 28, 3 ha, and Gampong Deah Raya The planned green open space area is 107.4 ha while the existing area is 44.4 ha. The projected need for green open space is based on an area of 1,227.18 ha. The projected need for green open space is based on population for 2033 with a population of 286,490 requiring green open space covering an area of 572.98 ha and in 2043 with a population of 315,525 requiring green open space covering an area of 631.05 ha.

E-mail:

dheaasmaulhusna@gmail.com

Copyright © 2023 Economic Journal. All rights reserved.

is Licensed under a Creative Commons Attribution-NonCommercial 4.0
International License (CC BY-NC 4.0)

1. INTRODUCTION

The development of a region generally coexists with the growth process of that region. In the development and growth of urban areas, there is often a process of land use change which is used to meet the needs of urban communities for infrastructure and facilities needed for urban growth. The process of development and urban development generally tends to marginalize the ecological value of land to be replaced with more economical functions.

Changes in land use for building buildings in urban areas and increasing demand for land certainly have an impact on increasingly limited land. Land use determines the service baseline of existing land cover types so that it has a big impact when making the right decisions regarding green infrastructure (Rottle, 2015). Population growth will also affect the availability of land and the existence of green open spaces in urban areas. The increase in urban population encourages an increase in social and economic activities in the city, causing an increase in land demand (Amiruddin, 2014). Urban areas continue to develop, and the role of green open space in the city is increasingly important (Chang et al., 2017; Hosaka & Numata, 2016; Palmer, 2018). An urban area that is filled with plants or crops, whether endemic or introduced, and which have direct or indirect benefits is called urban green open space (GOS).

Suitability And Projection Of Land Use For Green Open Space In Gampong Tibang, Deah Raya And Alue Naga Syiah Kuala District Banda Aceh City. Dhea Asmaul Husna, et.al

(Groenewegen et al., 2006; Dixon & Wolf, 2007). Apart from that, the existence of green open space is very important to preserve water and land (Ruslan & Rahmad, 2012).

Green Open Space (GOS) has many functions, especially for the environment. According to the Directorate of Building and Environmental Management, the function of green open space is to reduce pollutants, produce oxygen, improve climate quality, control radiation produced from the sun, increase aesthetic value and serve as a place for social interaction. The existence of green open space is very necessary for urban areas. It is hoped that the existence of green open spaces can overcome environmental quality problems caused by urban activities. Green open space has a role as a regulator of urban microclimate which can reduce surface temperature directly influence the distribution of air temperature and improve people's quality of life (Ahmad et al., 2012). Even though it is regulated by law and has many benefits, not all cities can provide adequate green open space, one of which is the city of Banda Aceh.

The city of Banda Aceh has geographical, topographic and hydrological conditions that are prone to floods, tornadoes, earthquakes and tsunamis (Banda Aceh City Qanun No. 3 of 2011). Not only that, based on information from the National Disaster Management Agency (BNPB, 2011), the City of Banda Aceh has a "high" disaster risk index value and has a national ranking of 15th level of the total disaster risk index values for districts/cities in Indonesia. Therefore, comprehensive efforts are needed to reduce disaster risk in this area on an ongoing basis by developing green open spaces considering the potential for disasters in Banda Aceh City.

Green open space is an area that must be provided by a city because it has an important role and benefits both ecologically, economically, socio-culturally and architecturally (Chiesura, 2004; Zhou and Wang, 2011 in Yuhong et al., 2014). Green open space is an area that must be provided by a city, this is by the provisions in the Regulation of the Minister of Agrarian Affairs and Spatial Planning/Head of the National Land Agency of the Republic of Indonesia Number 14 of 2022 concerning the Provision and Utilization of Green Open Space Chapter II Typology of Green Open Space Article 3 most at least 30% (thirty percent) of the city or urban area consists of public green open space of at least 20% (twenty percent) and private green open space of at least 10% (ten percent).

The Banda Aceh City Government continues to strive to provide Green Open Space (GOS) which can not only be used as a means of recreation for city residents but also to improve urban air quality which is subject to pollution (DKK Banda Aceh City, 2013). The distribution of green open space is adjusted to the population distribution and the hierarchy of the city's spatial structure. According to data released by the Central Statistics Agency (BPS) of Banda Aceh City in 2021, Banda Aceh City, Banda Aceh, is between 05°30' - 05°35' N latitude and 95°30' - 99°16' E longitude, consisting of 9 sub-districts, 17 mums and 90 Gampongs with a total area ± 61.36 km² (6,136 ha) with a population of 219,744 people. The need for Banda Aceh's green open space based on area is 1,227.18 ha, recorded in 2021, the total area of Banda Aceh City's existing green open space is currently 2,077.28 ha or 33.85% of the city area. This area meets the provisions that must be provided in the Regulation of the Minister of Agrarian Affairs and Spatial Planning/Head of the National Land Agency of the Republic of Indonesia Number 14 of 2022 concerning the Provision and Utilization of Green Open Space, however, the percentage is reversed. The existing public green open space area of 845.23 ha or 14.33% is still 5.67% short of the stipulated minimum area, whereas the existing private green open space area of 1,197.74 ha or 19.52% has exceeded the minimum area that has been determined, namely 10% of the area even though the distribution is uneven.

The lack of public green open space in all sub-district areas in Banda Aceh City is due to the lack of optimal greening programs, especially the addition of city parks, city forests, and city green lanes, in addition to their uneven distribution. To meet the minimum need for public green open space, this can be done by maintaining the existing green open space and increasing the area of public green open space by turning urban/increased agricultural green open space into city parks and urban forests or establishing special areas such as water catchment areas, mangrove forests into natural tourist parks or protected forests.

Syah Kuala District by the Banda Aceh City Up-Scaling Green Open Space (GOS) Masterplan 2013-2033 has an area of 1,424.40 Ha with the need for green open space based on area area being 427.32 Ha of public GOS and 142.44 Ha of private GOS, however Availability of public open space in Syah Kuala District 285.34 Ha. This means that there is still a shortage of 141.98 Ha of public green open space due to less than optimal development of green open space. Based on the Banda Aceh City spatial pattern plan for 2009-2029, Gampong Tibang, Alue Naga and Deah Raya are areas prioritized for green open space development. These three Gampongs have an area of 596.2 Ha including the area of Tibang 203.3 Ha, Deah Raya 102.4 Ha and Alue Naga 290.5 Ha (BIG). These three Gampongs are located on the coast of

Suitability And Projection Of Land Use For Green Open Space In Gampong Tibang, Deah Raya And Alue Naga Syiah Kuala District Banda Aceh City. Dhea Asmaul Husna, et.al

Banda Aceh City. Green open space planning in this area is to fulfill 20% of public green open space in Banda Aceh City. Apart from that, green open space planning also functions as an effort to protect against disasters (disaster mitigation). In various urban areas, the area of green open spaces tends to decrease and changes in green open spaces are influenced by the conversion of green open spaces (Sitorus et al., 2013).

However, the green open space in this area is still not optimal because of several problems, including that almost all of the existing green open space areas are ponds whose ownership status is owned by the local community and a lot of empty land that is abandoned is not used as intended. With the existence of problems related to green open space in the study location, it is necessary to evaluate the suitability of green open space use in the area so that it can be a solution to the green open space problems and achieve the specified 30% green open space requirement.

Journal objectives:

1. Analyze the extent and distribution of green open space in Gampong Tibang, Deah Raya and Alue Naga, Banda Aceh City.
2. Analyze the suitability of land use for green open spaces in Gampong Tibang, Deah Raya and Alue Naga, Banda Aceh City.
3. Projection of the need for green open space in Gampong Tibang, Deah Raya and Alue Naga, Banda Aceh City in 2033-2043.

2. METHOD

According to Creswell and Clark (2011), "Mixed research methods is a research design with philosophical assumptions such as inquiry methods. As a methodology, it involves philosophical assumptions that guide the direction of data collection and analysis and a mix of qualitative and quantitative approaches in many phases of the research process. As a method, it focuses on collecting, analyzing, and mixing quantitative and qualitative data in one study. The main premise is that using a combination of quantitative and qualitative approaches provides a better understanding of the research problem than using either approach alone.

According to Aramo-Immonen (2013), a mixed method is an approach that combines or associates quantitative and qualitative forms in one series of research, where this method provides researchers in all research disciplines with breadth in exploring research problems. Meanwhile, according to Schoonenboom & Johnson (2017), mixed methods research is a type of research in which a researcher or research team combines elements of qualitative and quantitative research approaches (for example, the use of qualitative and quantitative points of view, data collection, analysis, inference techniques) for broad purposes and depth when understanding and carrying out proofs. This research uses mixed methods.

The analysis technique used to answer the research problem formulation is as follows:

1. Visual interpretation of satellite imagery is an image study activity aimed at identifying the land cover depicted in the image (Purwadhi., 2001). The elements of interpretation of Landsat 8 satellite imagery that are observed are texture, pattern, shape, color, size, shadow and association. This visual interpretation can be carried out before the ground check goes to the field so that researchers get an idea of the condition of the area and the location of the research object. This on-screen digitizing process uses digital maps to be digitized and Banda Aceh City regional spatial planning (RTRW) maps in the form of Softcopy shapefiles (shp) as raw data by selecting several polygons with certain areas according to the land cover group. Data analysis for green open spaces using the geographic information system (GIS) application ArcGIS 10.8 Software
2. The analysis technique used in this research is an overlay technique with the help of GIS software, namely overlaying the existing land use map in 2022 with the spatial pattern map of Banda Aceh City 2009-2029. Next, the overlay results are queried based on a logic matrix of suitability of land use types with spatial patterns which produces a map of suitability of space use. Indications of conformity or non-conformity are carried out by looking at deviations that occur in the field in areas that have been allocated and determined in the RTRW spatial pattern. If the use of existing land is by the spatial pattern then the land is said to be harmonious. On the other hand, if it is not suitable then the land is said to be incongruent, and if the existing land use is not yet by the spatial pattern but it is still possible to return to conformity with the spatial pattern it is called transitional, for example, the current land use is rice fields, but based on the regional spatial plan it is a zone. residential or industrial.

3. Analysis of green open space needs in the study area is carried out in 2 stages, namely calculating the area of green open space needed based on population and area. The need for green open space based on population is done by multiplying the number of residents by the standard area of green open space per resident.

Geometric Population Projection Formula :

$$P_n = P_o (1+r)^n$$

Information:

P_n = Population projection for a particular year

P_o = Population at the beginning of the year

1 = constant

r = population growth rate

n = range of years

$$GOS = P_i \times k \text{ (m}^2\text{/person) (i)}$$

Information:

P_i : Number of residents in region i ,

k : Value of green open space provisions per resident

Based on Minister of Public Works Regulation No. 05/PRT/M/2008

4. Develop development plan directions to fulfill the area of green open space in Banda Aceh City. The preparation of directions for the development of green open space (GOS) is carried out by synthesizing existing conditions, adequacy of green open space, and potential areas and land values to be developed into green open space, guided by the RTRW. There are two considerations in the activity of preparing a rational land use plan, namely the current state of land use and potential land use (Sitorus 2014). Potential land is determined from land use data for Banda Aceh City in 2022. Green open space development planning prioritizes the use of existing land that is not yet or is under-used economically. This direction is a form of control over changes in land use so that changes do not occur in undesirable directions, and is also expected to be an effort to prevent green open space conversion and a solution to overcome the problem of lack of green open space.

3. RESULTS AND DISCUSSION

Extent and Distribution of Green Open Space in Gampong Tibang, Deah Raya and Alue Naga

The extent and distribution of green open space in the Gampong Tibang, Deah Raya and Alue Naga areas can be seen based on an analysis of the area. To see the area and distribution in Gampong Tibang, Deah Raya and Alue Naga, an analysis was carried out with the help of the Geographic Information System (GIS) using Landsat satellite imagery. The parameters analyzed are the area and distribution of green open space in the Gampong Tibang, Deah Raya and Alue Naga areas in 2023. Gampong Tibang's green open space in 2023 will have an area of 36.7 ha, which can be seen in Figure 1 Distribution of Gampong Tibang's green open space, the distribution of green open space is growing very little when compared to the area of Tibang, namely 203.3 ha. When compared with the 2009-2029 Banda Aceh City spatial pattern plan, Gampong Tibang, which is also a priority area for green open space development, is not yet reflected as an area designated as green open space.

Gampong Deah Raya GOS in 2023 will have an area of 28.3 ha, which can be seen in Figure 2 Distribution of Gampong Deah Raya GOS, the Gampong Deah Raya GOS distribution also has very little growth when compared to the area of Deah Raya, namely 102.4 ha. by settlements, settlements should be far from coasts that are prone to disasters. The area and distribution in Gampong Alue Naga in 2023 has an area of 44.4 ha which can be seen in Figure 3 Distribution of the Gampong Alue Naga green open space, the Gampong Alue Naga green open space distribution also has very little growth when compared to the area of the Deah Raya area, which is 290.5 ha. The small area and distribution of green open space is due to the cutting down of green open space which is used for firewood, this is not good for the growth of green open space. The government has made efforts to expand and spread the growth of green open space, especially mangroves, starting from seed assistance provided to Gampong Tibang, Deah Raya and Alue Naga as well as NGO/private activities, but there is no scheduled program for mangrove seed assistance and there is no further cooperation so it is not optimal. assistance from the government.

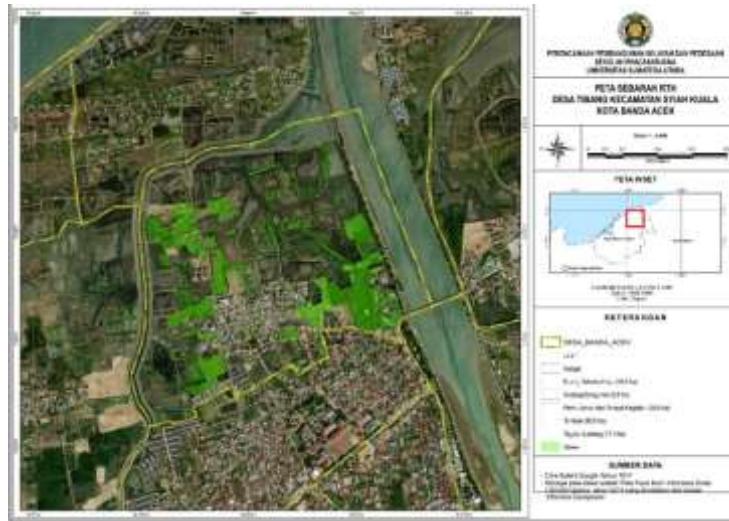


Figure 1. Distribution of Green Open Space in Gampong Tibang
Source: Arc GIS

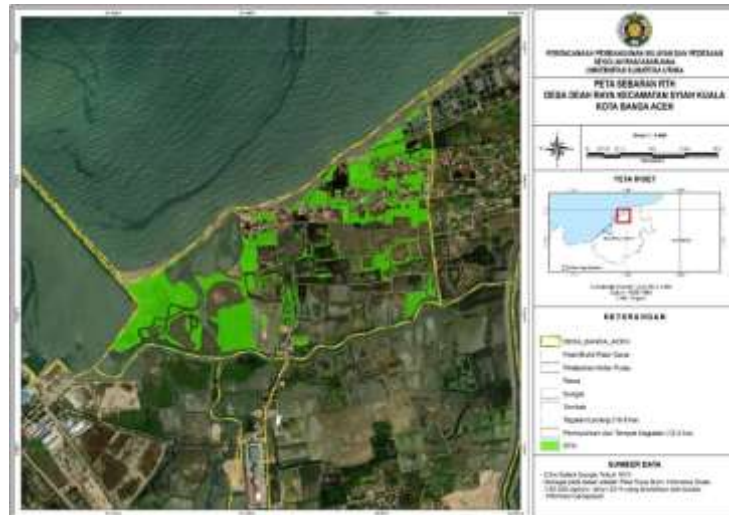


Figure 2. Distribution of green open space in Gampong Deah Raya
Source: Arc GIS



Figure 3. Distribution of green open space in Gampong Alue Naga
Source: Arc Gis

Suitability of Land Use for Green Open Space in Gampong Tibang, Deah Raya and Alue Naga

The suitability of land use for green open space in Gampong Tibang, Deah Raya and Alue Naga is seen as indications of whether it is appropriate or not by looking at deviations that occur in the field in the areas that have been allocated and determined in the Banda Aceh City RTRW spatial pattern. If the use of existing land in 2023 is by the spatial pattern then the land is said to be suitable. On the other hand, if it is not aligned then the land is said to be unsuitable. The suitability of land use with the RTRW spatial pattern is presented in the figure and the area is presented in the table.

Table 1. Suitability of GOS Land Use

No.	Gampong	Green open space area Space Pattern (Ha)	Existing Green Open Space Area (Ha)	information
1.	Tibang	88,6	36,7	It is not by
2.	Deah Raya	84,2	28,3	It is not by
3.	Alue Naga	107,4	44,4	T It is not by
	Total	280,2	109,4	It is not by

The suitability of land use for green open space in Gampong Tibang can be seen in the map in Figure 4 The area of existing green open space is 36.7 ha, which is very different from the total area of green open space for the spatial pattern, which is 88.6 ha. This shows that the area of green open space does not match the existing conditions and the spatial pattern of green open space, the difference in the area of green open space is 51.9 ha. The deficiency in existing green open space is quite large, even exceeding 50%.

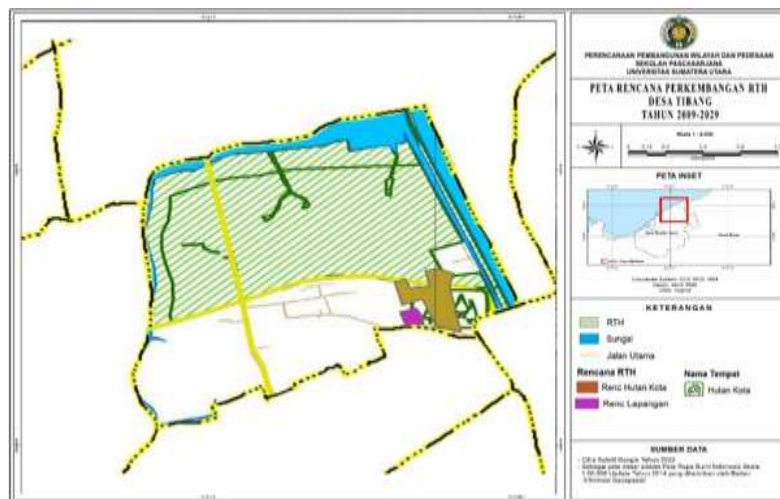


Figure 4. Map of Suitability of Gampong Tibang Land Use

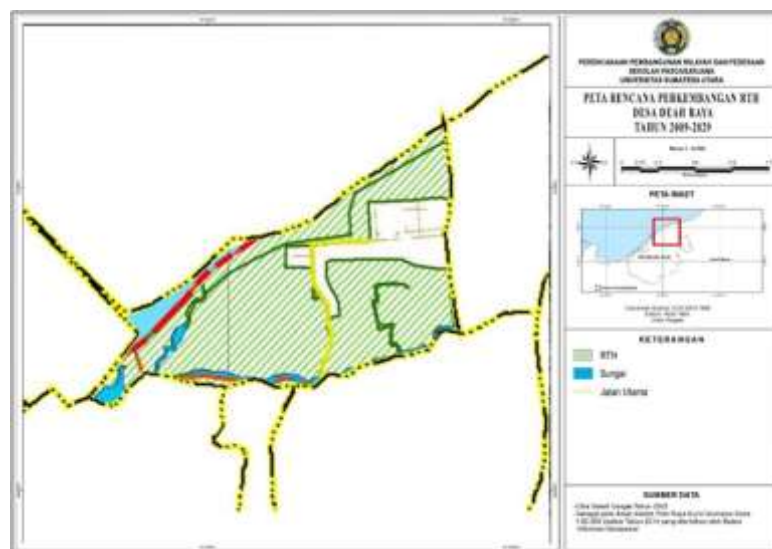


Figure 5. Map of Gampong Land Use Suitability

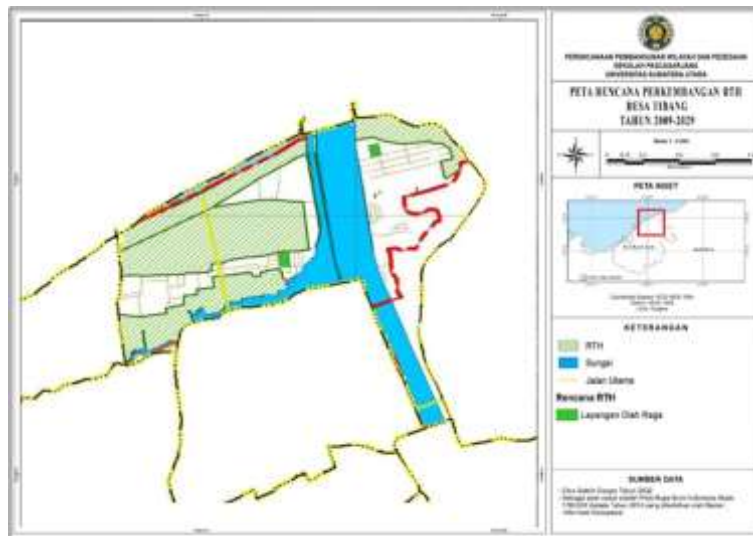


Figure 6. Map of Suitability of Land Use in Gampong Alue Naga

Suitability of land use for green open space in Gampong Deah Raya. The existing green open space area is 28.3 ha, which is also very different from the total spatial pattern green open space area, which is 84.2 ha. The discrepancy also occurred in Gampong Deah Raya, the difference in green open space area reached 55.9 ha, even the lack of green open space in Gampong Deah Raya compared to the shortage in Gampong Tibang. Suitability of land use for green open space in Gampong Alue Naga. The existing green open space area is 44.4 ha, which is also very different from the total spatial pattern green open space area, which is 107.4 ha. Gampong Alue Naga also experienced a discrepancy in the area of green open space, the difference in green open space area reached 63 ha, and the discrepancy in the area of green open space in Gampong Alue Naga was the highest.

Evaluation of suitability of Land Use with RTRW Spatial Patterns. Indications of suitability or non-conformity are carried out by looking at deviations that occur in the field in areas that have been allocated and determined in the RTRW spatial pattern. If the use of existing land in 2023 is by the spatial pattern then the land is said to be suitable. On the other hand, if it is not in harmony then the land is said to be unsuitable, and if the existing land use is not yet by the spatial pattern but it is still possible to return to conformity with the spatial pattern, it is called transitional, for example, the current land use is rice fields, but based on the regional spatial plan it is considered an area. residential or industrial. As time goes by, there is a possibility that the use of rice fields will change to residential or industrial.

Table 2. Suitability of Land Use in the Study Area

Land use 2023	RTRW spatial pattern				
	OS	Tourist	Settlements and Places of Activity	Fisherie s/Ponds	Trade and Services
GOS		T	T	T	T
Pond		T	T	Y	T
Settlements and Places of Activity		X	Y	X	T
Other		T	T	T	T

Projection of Green Open Space Needs

GOS Needs to Be Based on Area

Regulation of the Minister of Agrarian Affairs and Spatial Planning/Head of the National Land Agency of the Republic of Indonesia Number 14 of 2022 concerning the Provision and Utilization of Green Open Space specifically mandates the need to provide and utilize green open space whose area proportion is set at least 30% of the area of the City which consists of 20 % Public Green Space and 10% Private Green Space.

Table 3. Need for Green Open Space Based on the Size of the Research Area

No.	Gampong Name	Area (Ha)	Green Open Space Requirements (Ha)		
			Public	Privat	Total
1.	Tibang	205,5	41,1	20,55	61,65
2.	Deah Raya	166,9	33,38	16,69	50,7
3.	Alue Naga	220,8	44,16	22,08	66,24
	Total	593,2	118,64	59,32	178,59

The projected need for green open space in Gampong Tibang, Deah Raya and Alue Naga with an area of 59.32 Ha, must provide 178.59 Ha of green open space, consisting of 118.64 Ha of public green open space and 59.32 Ha of private green open space.

Table 4. Adequacy of Green Open Space Based on the size of the Research Area

No.	Gampong Name	Green Open Space Requirements (Ha)	Available (Ha)	Adequacy (Ha)
1.	Tibang	61,65	36,7	-24,95
2.	Deah Raya	50,7	28,3	-22,4
3.	Alue Naga	66,24	44,4	-21,84
	Total	178,59	109,4	-69,19

After getting the results of green open space requirements in Gampong Tibang, Deah Raya and Alue Naga and the results of digitization using ArcGIS, we produced the value of green open space adequacy. The adequacy value can be seen in Table 4 that there is still a lack of adequacy value for green open space in Gampong Tibang, Deah Raya and Alue Naga, where in Gampong Tibang the area of 24.95 Ha is not yet sufficient, Gampong Deah Raya the area is not yet sufficient, covering an area of 22.4 Ha, and in Gampong Alue Naga is not yet covered with an area of 21.84 hectares, thus explaining that Gampong Tibang does not have enough of the largest green open space. The total unsatisfied study area is 69.19 Ha.

Based on the spatial pattern plan for the City of Banda Aceh for 2009-2029, Gampong Tibang, Alue Naga, and Deah Raya are areas that are prioritized for the development of green open space for the city of Banda Aceh, so the projection of the need for green open space is also projected based on the area of the city of Banda Aceh to see the needs. GOS Banda Aceh City. Based on what is stipulated by this Law, the Banda Aceh City area with an area of 6,136.00 Ha, must provide 1,840.77 Ha of green open space, consisting of 1,227.18 Ha of public green open space and 613.59 Ha of private green open space. The distribution of the need for green open space in Banda Aceh City in each sub-district can be seen in Table 5 Need for green open space based on the area of Banda Aceh City.

In the table above, it can be seen that the greatest area of green open space needs is in Syiah Kuala District, which is the sub-district of the study area. One of the green open space development areas in the study area is Gampong Tibang, Alue Naga, and Deah Raya. The existing area of public green open space in the Syiah Kuala sub-district still does not meet the needs for the public green open space Syiah Kuala sub-district which can be seen in Table 5

Table 5. Need for GOS Based on Area of Banda Aceh City

NO	Subdistrict	Area (Ha)	Green Open Space Requirements (Ha)		
			Public	Public	Public
1	Meuraxa	725,8	145,16	72,58	217,74
2	Jaya Baru	378	75,6	37,8	113,4
3	Banda Raya	478,9	95,78	47,89	143,67
4	Baiturrahman	453,9	90,78	45,39	136,17
5	Lueng Bata	534,1	106,82	53,41	160,23
6	Kuta Alam	1.004,70	200,94	100,47	301,41
7	Kuta Raja	521,1	104,22	52,11	156,33
8	Syiah Kuala	1.424,40	284,88	142,44	427,32
9	Ulee Kareng	615	123	61,5	184,5
	Total	6.136,00	1.227,18	613,59	1.840,77

In the table above, it can be seen that the adequacy of public green open space in the city of Banda Aceh does not yet meet the public green open space needs, namely 1,227.18 ha, still 550.91 ha short. Meanwhile, private green open space is already sufficient. Untuk kebutuhan GOS publik di Kota Banda Aceh kawasan Gampong Tibang, Deah Raya dan Alue Naga jika dimaksimalkan mampu membantu 170,8 ha sehingga menjadi 1.016,03 ha.

Table 6. Adequacy of Green Open Space Based on Area of Banda Aceh City.

City	Green Open Space Requirements (Ha)		Available (Ha)		Adequacy	
	Public	Privat	Public	Privat	Public	privat
Banda Aceh	1.227,18	613,59	845,23	1.401,00	381,95	+787,41

Green Open Space Needs Based On Population

The population growth of Banda Aceh City is an average of 0.97% per year, using the multiple interest model equation, namely $P_n = P_o (1+r)^n$ projected in 2033 to be 286,490 residents and in 2043 to be 315,525 residents. Based on these standards, the need for green open space in 2033 is 660.74 Ha.

Population projections for 2033 :

$$\begin{aligned}
 P_n &= P_o (1+r)^n \\
 &= 257,635 (1 + 0,97\%) (2033-2022) \\
 &= 257,635 (1 + 0,97\%)(11) \\
 &= 257,635 (1,0097)(11) \\
 &= 257,635 (1,1120) \\
 &= 286,490 \text{ people.}
 \end{aligned}$$

Population projections for 2043 :

$$\begin{aligned}
 P_n &= P_o (1+r)^n \\
 &= 257,635 (1 + 0,97\%) (2043-2022) \\
 &= 257,635 (1 + 0,97\%)(21) \\
 &= 257,635 (1,0097)(21) \\
 &= 257,635 (1,2247) \\
 &= 315,525 \text{ people.}
 \end{aligned}$$

Table 7. Need for Green Open Space Based on Population in 2033 and 2043

Banda Aceh City	population (people)	GOS (ha)		
		Need	Available	Adequacy
2033	286.490	572,98	2.077,28	+ 1.504,3
2043	315.525	631,05	2.077,28	+ 1.446.23

The availability of green open space in Banda Aceh City is 2,077.28 ha. This figure is very high when compared to the need for green open space, and the adequacy of green open space in 2033 will reach 1,504.3 ha and in 2043 it will reach 1,446.23 ha. Based on the Banda Aceh City RTRW, ideally, the Green Open Space (GOS) for the study area functions as a barrier/greenbelt in the form of mangrove plants that protect the residential area and the sea. Based on the disaster vulnerability in the study area, the potential for mangroves can be used as a natural protection to withstand tidal waves, coastal erosion and tsunami waves. This is the right choice to reduce disaster risk in tsunami-prone areas.



Figure 7. Condition of Mangroves at the Study Location

Bengen (2001) explains that mangrove forests function as wave and wind absorbers, protect against abrasion, retain mud and trap sediment. The soil type in Gampong Tibang, Deah Raya and Alue Naga is a sand structure that is identical to the existence of ponds and swamps. The soil conditions in Alue Naga are a type of soil that is very sensitive to erosion because of the sand structure. Thus, soil strengthening is carried out by planting mangroves to form a denser soil structure. Mangroves commonly

called mangal or mangroves are vegetation typical of tropical areas. This plant can adapt to water that has quite high salt levels. Mangroves are a variety of coastal communities dominated by several species of trees and shrubs (Nybakken 1987). Mangroves are part of coastal and marine resource ecosystems that have ecological and economic functions. Mangroves also have quite high biodiversity (Handayani, 2004).

The buffer zone is the area directly adjacent to the shoreline and land. This area should have a forested protected area. This is intended to protect the area around the coast against abrasion, tidal waves and tsunamis. To maintain environmental security and stability, the coastal areas of Gampong Tibang, Deah Raya and Alue Naga should have a buffer zone to prevent coastal erosion. In the study area, a small part already has a buffer zone covered with mangroves, with ages ranging from 2-3 years. The flat and short geomorphology of the beaches of Gampong Tibang, Deah Raya and Alue Naga is one of the factors that makes this area very important for planting. The current condition of mangrove forests on the coast of the study area is generally in a condition of heavy damage after the tsunami and has just begun to be replanted. This condition results in disruption of environmental sustainability. The pond system used by pond farmers in the study area before the tsunami until now is non-mangrove ponds. Mangrove plants have a dual function. Apart from being able to absorb residual toxins resulting from the use of pesticides or chemical fertilizers, the roots also provide natural food for aquatic animals, and the roots can become a place to lay eggs for several types of fish or shrimp.

Apart from being a buffer zone and protection zone, the development of mangroves will also be directed at cultivation businesses based on sustainable aquaculture. This means that the economic value of cultivation can be utilized, while still maintaining the quality of the environment. Through the silvofishery system, for example, the allocation for mangroves will be 50 percent of the existing pond area, because the presence of mangroves is very important for water productivity as well as being the best natural reservoir that can be carried out by polyculture with milkfish and gracillaria seaweed. Meanwhile, the other 50 percent is for shrimp cultivation. The silvofishery concept is a solution to bridge the conflict of interest between the use of coastal protected forests and the use of pond cultivation for fish, shrimp and brackish water crabs. Silvofishery is a technical approach pattern that consists of a series of integrated activities between fish, shrimp or soft crab cultivation activities, with planting, maintenance, management and efforts to preserve mangrove forests. Pond development is carried out by planting mangroves in it, which is in harmony with tidal fluctuations in seawater, and can also function as nature conservation (habitat), green open space or green belt, economic/production, and recreation.



Figure 8. Condition of Ponds Without Mangroves and Mangrove Crab Pond Farmers

Several benefits can be obtained by implementing silvofishery, namely:

1. The construction of the pond embankment will be strong because it will be supported by the mangrove roots of the mangrove trees planted along the pond embankment and the embankment will be comfortable for pedestrians to use because it will be covered with a canopy of mangrove plants;
2. The research results of Martosubroto and Naamin (1979) show that there is a significant relationship between the area of mangrove areas and aquaculture production, whereas the area of mangroves increases, the production of aquaculture also increases;
3. Increase production from natural catches and this will increase the income of fish farming communities.

In addition, community economic activities can also be directed to other fields that do not directly touch the mangrove forest or the community can explore and utilize other economic potential from the mangrove forest, namely: 1) ecotourism potential, 2) shellfish cultivation, 3) oyster cultivation, 4) fish

Suitability And Projection Of Land Use For Green Open Space In Gampong Tibang, Deah Raya And Alue Naga Syiah Kuala District Banda Aceh City. Dhea Asmaul Husna, et.al

cultivation, 5) shrimp cultivation, and others. A spatial planning pattern that might be able to fulfill the natural function of coastal protected forests but also meet the need for land to provide employment opportunities for the community is shaped like an intercropping pattern, where the location of coastal protected forest land alternates with the location of silvofishery land. The dimensions of each designation depend on how large the mangrove forest is so that marine biota activities that use the lagoon as a spawning ground, nursery ground, or feeding ground can take place naturally there. Likewise, the calculation of incoming seawater discharge as a process of pond water circulation follows the tidal pattern on the beaches of Gampong Tibang, Deah Raya and Alue Naga.

The types of models for implementing silvofishery or wanamina that can be applied in ponds are:

1. Empang Parit Model, namely planting mangrove trees directly in the fish farming area. In this model, mangrove trees and fish cultivation are on one land using one sluice gate. The mangrove forest is placed in the center and at the edges there is an area for fish to swim freely.



Gambar 9. Silvofishery Model Empang Parit

2. Komplang model, where the land for planting mangrove forests and fish farming is separated using embankments. However, there is a floodgate that connects the two. In this model, one pond area is divided into two parts with 2 sluice gates. The first sluice gate leads to the fish cultivation area, and the second to the mangrove trees.

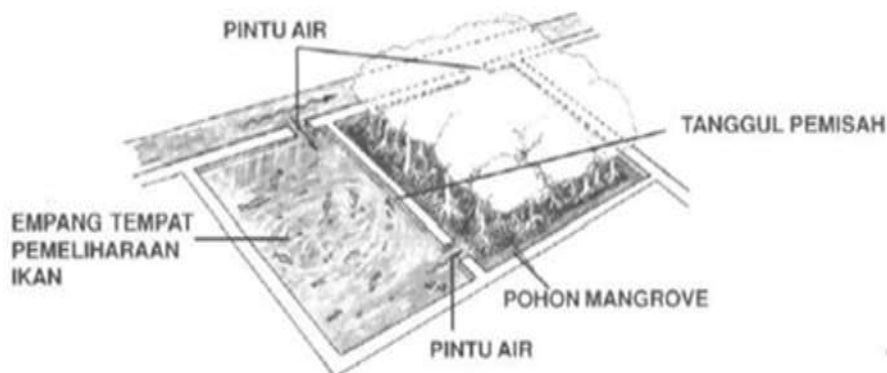


Figure 10. Silvofishery Model Komplangan

In the komplangan pattern, the fish farming area and the mangrove forest area are separated by a bund and equipped with 2 sluice gates each for water intake and output. On forest land, there are free tidal water gates (Apriyanto, 2011). The Komplangan model is a silver-fishery system with a pond design alternating or adjacent to land that will be planted with mangroves. The land for mangroves and ponds is separated into two stretches which are regulated by an atmospheric channel with two separate atmospheric gates. The area that will be used for silvofishery with this indication is recommended to be between 2-4 ha so that later a standard pond size for keeping fish/shrimp will be developed, at least 1 ha. This model is a brackish atmosphere cultivation method with low yield and produces minimal negative impacts on the environment (ecosystem).

The komplangan system which is applied perpendicular to the coastline allows several fresh atmosphere flows to the mangroves in the greenbelt area. This model can also maintain the abundance of natural biodiversity resources. In its implementation, this silvofishery indication komplangan is more suitable to be applied in areas with clear ownership, such as land owned by the government or land owned by community groups. The advantage of the komplangan pattern is that it is a more integrated form, and gets enough sunlight so it can be used for semi-intensive cultivation (Apriyanto, 2011). Advantages of the komplangan pattern: integrated with sunlight, semi-intensive cultivation can be implemented and the development of mangrove forests and fish and shrimp do not hinder each other (Warta Conservation, 2004). The area ratio between mangrove stands and ponds is 4:1 in both the komplangan pattern and the enhanced trench pond pattern (Perum Perhutani) (Warta Conservation, 2004).

3. Path/Embankment Model, which is the most commonly used model in Indonesia. This model places mangrove trees on the inside of the pond right on the embankment or embankment. Apart from providing direct benefits to fish, the presence of mangrove trees can also strengthen pond embankments. The strip model silvofishery pond is the result of a modification of the ditch pond model silvofishery pond. In this model of the pond, channels are added in the middle which functions as a pond. Meanwhile, in the embankment model, mangrove forests are only found around the embankment.



Figure 11. Silvofishery Line Model and Embankment Model

Based on the 3 silvofishery patterns and the patterns developing in the community, for Gampong Tibang, Deah Raya and Alue Naga the silvofishery pattern combined with ditch ponds and embankments is recommended. The choice of this pattern is based on considerations:

1. Planting mangroves on embankments aims to strengthen the embankments against landslides so that embankment repair costs can be reduced and litter production can be reduced.
2. Planting mangroves in the middle aims to maintain a balance in changes in water quality and increase fertility in the pond area.
3. The concept of a combination of ditches and embankments is quite well implemented. Shrimp and fish seem to live in their natural habitat. In summer, shrimp and fish can take shelter under the mangrove trees. Meanwhile, mangrove tree roots provide natural food for shrimp and fish.

This condition can be applied to the area of the former pond which will be rehabilitated by using the pond yard (middle part) to be planted with mangroves while the caren or ditch section remains as it is, and the embankment section is also planted with mangroves. The type of mangrove that is usually planted on embankments is *Rhizophora* sp. and *Xylocarpus* sp. Meanwhile, in the middle/court of the pond is *Rhizophora* sp. The spacing for mangrove planting in the yard is generally 1m x 2m when the mangroves are still small. After they grow larger (4-5 years) mangroves must be thinned. The purpose of this thinning is to provide wider space for cultivated commodities. Apart from that, more sunlight can enter the pond and touch the bottom of the yard, to increase the fertility of the pond. The ditch Ampang model consists of 80% mangroves and 20% ponds with mangroves located in the middle position and surrounded by a ditch with a width of 3-5 m and 40-80 cm below the embankment. The mangrove-pond composition can be changed by up to 40-60% of the pond area. The types of aquatic animals that are often cultivated in this type of pond are fish, shrimp and crabs (Gunawan et al. 2007).

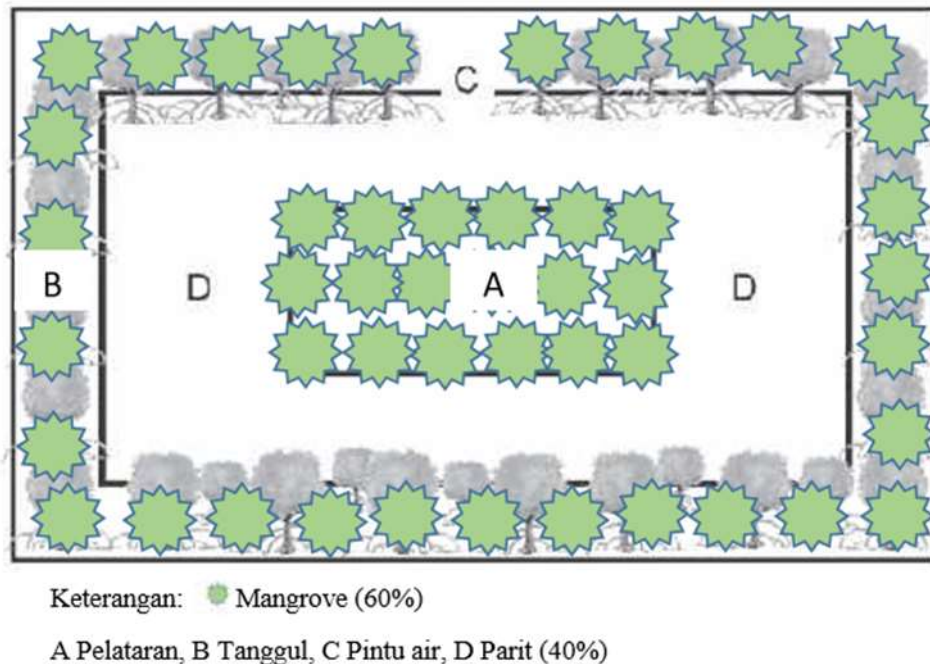


Figure 12. Recommendations for Silvofishery Pond Models applied by Gampong Tibang, Deah Raya and Alue Naga
Source: Analisis

According to Soewardi (1994) in Dewi (1995), differences in tides, elevation and slope will determine some of the water depths in the pond. This depth is very important to regulate the temperature in the pond. The ideal temperature for shrimp cultivation is around 28 °C-32 °C. This temperature can be maintained if the pond depth is not less than 80 cm. If the tidal conditions do not reach a depth of 80 cm, then milkfish pond activities should be carried out.

A suitable fishery commodity for silvofishery cultivation in mangrove areas is mangrove crab. Mud crabs have characteristics that are slightly different from other commodities because of their ability to survive in conditions of lack of water. Therefore, cultivating crabs does not require large ponds (Triyanto, et al., 2012). According to Fitzgerald (1997) in Mwaluma (2002), rearing mangrove crabs (*Scylla serrata*) can be combined with rearing snapper and milkfish and shrimp which are reared using an open cage system. From various studies, it is known that fallen mangrove leaves that fall into the water will become a good substrate for bacteria and fungi, which also function to help the process of decomposing the leaves into detritus. Detritus will be used by detritus eaters such as amphipods, mysidaceae, and others. Detritus eaters will be eaten by larvae, fish, crabs, shrimp, etc. In other words, detritus will provide essential energy for most estuarine animals.

4. CONCLUSION

The extent and distribution of green open space in the Gampong Tibang, Deah Raya and Alue Naga areas was analyzed with the help of the Geographic Information System (GIS) using Landsat satellite imagery. Gampong Tibang GOS in 2023 will have an area of 36.7 ha, then Gampong Deah Raya GOS in 2023 will have an area of 28.3 ha and Gampong Alue Naga Pata in 2023 will have an area of 44.4 ha. Suitability of land use for green open space in Gampong Tibang. The existing green open space area is 36.7 ha, which is very different from the total spatial pattern green open space area, which is 88.6 ha. suitability of land use for green open space in Gampong Deah Raya. The existing green open space area is 28.3 ha, which is also very different from the total spatial pattern green open space area, which is 84.2 ha. The discrepancy also occurred in Gampong Deah Raya, the difference in green open space was 55.9 ha. Suitability of land use for green open space in Gampong Alue Naga. The existing green open space area is 44.4 ha, which is also very different from the total spatial pattern green open space area, which is 107.4 ha. Gampong Alue Naga also experienced a discrepancy in the area of green open space, the difference in green open space area reached 63 ha, and the discrepancy in the area of green open space in Gampong

Alue Naga was the highest. Projected green open space needs based on the area of Gampong Tibang, Deah Raya and Alue Naga with an area of 593.2 Ha, must provide 178.59 Ha of green open space consisting of 118.64 Ha of public green open space and 59.32 Ha of private green open space. There is a lack of adequacy of green open space in Gampong Tibang, Deah Raya and Alue Naga, Gampong Tibang does not yet cover an area of 24.95 Ha, then in Gampong Deah Raya is not yet sufficiently covered area of 22.4 Ha, and in Gampong Alue Naga it is not yet sufficient covering an area of 21.84 Ha. The projected results are that in 2033 the population of Banda Aceh City will be 286,490 people and in 2043 the population of Banda Aceh City will be 315,525 people. Based on these standards, the green open space requirement in 2033 is 572.98 ha and the green open space requirement in 2043 is 631.05 ha. The availability of green open space in Banda Aceh City is 2,077.28 ha. This figure is very high when compared to the need for green open space, and the adequacy of green open space will reach 1,504.3 ha in 2033 and 1,446.23 ha in 2043.

REFERENCES

- [1] Rottle, N. D. (2015). Developing a Regional Open Space Strategy (ROSS) for Central Puget Sound, Washington State, USA. *ELSEVIER*, 62(2015):133-138.
- [2] Dixon, K., & Wolf, K. (2007). Benefits and risks of urban roadside landscape: finding a livable, balanced response. *Proceedings of the 3rd Urban Street Symposium*.
- [3] Ruslan, M., & Rahmad, B. (2012). Kajian ruang terbuka hijau dalam rangka pembentukan hutan Kota di Banjarbaru. *Jurnal Hutan Tropis*, 13(1), 73-91.
- [4] Ahmad, F., Arifi n, H. S., Dahlan, E. N., Eff endy, S., & Kurniawan, R. (2012). Analisis hubungan luas ruang terbuka hijau (RTH) dan perubahan suhu di Kota Palu. *Jurnal Hutan Tropis*, 13(2), 173-180.
- [5] BPS Kota Banda Aceh. 2021. Kecamatan Syiah Kuala Dalam Angka 2021.
- [6] Yuhong T., C.Y. Jim and W. Haiqing. 2014. Assessing the Landscape and Ecological Quality of Urban Green Spaces in a Compact City. *Landscape and Urban Planning*, 121: 97-108.
- [7] Sitorus, S.R.P., Ashri, M. dan Panuju, D.R. 2013. Analisis ketersediaan ruang terbuka hijau dan tingkat perkembangan wilayah di Kota cimahi, provinsi jawa barat. *Jurnal Tanah Lingkungan*. 15 (2):66-75.
- [8] Creswell JW, Clark VLP, 2011, *Designing and Conducting Mixed Methods Research*, California: SAGE.
- [9] Schoonenboom, J., Johnson, R., & Froehlich, D. (2018). Combining Multiple Purposes of Mixing Within a Mixed Methods Research Design. *International Journal of Multiple Research Approaches*, 10(1), 271-282.
- [10] Purwadhi FSH . 2001. *Interpretasi Citra Digital*. Jakarta (ID): Grasindo
- [11] Bengen DG. 2001. *Sinopsis Ekosistem dan Sumberdaya Alam Pesisir dan Laut*. Cetakan Kedua. Pusat Kajian Sumberdaya Pesisir dan Laut. Institut Pertanian Bogor. Bogor.
- [12] Nybakken, J.W. 1988. *Biologi Laut; Suatu pendekatan ekologis*. PT. Gramedia Jakarta