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Urban green space development plans and strategies in Sorong city Southwest Papua Province

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Abstract

The city administration considers implementing urban green open spaces a viable solution to meet Indonesia's Folu Net Sink 2030 target and the Long-Term Strategy for Low Carbon and Climate Resilience (LTS LCCR) 2050. This initiative addresses the urban environment's declining carrying capacity and resilience. The current urban green open space development level in Sorong City stands at 8.21%, which falls short of the 30% target mandated by the central government. The utilization of SWOT analysis is employed as a means to construct comprehensive plans and strategies. The findings indicate that the IFE value is 2.38, while the EFE value is 2.27. To mitigate the effects of potential threats, it is essential to ascertain the defensive mechanisms employed by the entity under consideration. A total of 110 weakness-threat (WT) strategies were identified through the collaborative efforts of managers and municipal environmental planners, who combined 10 weakness aspects with 11 threat components. Regrettably, a limited number of these hypothetical solutions demonstrated satisfactory performance. The Urban Green Open Space Development (UGOSD) initiative in Southwest Papua has found six viable Wakness-Threat (WT) alternatives to enhance the urban green infrastructure system.

Keywords: Urban; Green; Sorong City; SWOT; WT

1. Introduction

The establishment of Urban Green Open Space Development (UGOSD) serves as a means to address the challenges posed by climate change and to support Indonesia's Folu Net Sink 2030 [1,2,3]. Following this initiative, it is the responsibility of the regional government to ensure the provision of high-quality conditions while also considering various factors such as ecological functionality, water absorption, economic considerations, social and cultural aspects, aesthetics, and disaster management [4,5,6,7,8,9].

The current state of green open spaces in Sorong City falls significantly short of the targets established by the central government. Only 8.21% of the required provision of 20% for the public and 10% for the private sectors has been achieved [10,11]. Sorong City's green space deterioration has led to detrimental consequences in various sectors, notably flooding and landslides. These unfortunate events have resulted in the loss of human lives and the destruction of numerous residential properties within the affected parts of the city. In addition to the effects of climate change and extreme weather patterns, the northern shore of Sorong City experienced the passage of tropical cyclones on August 22-23, 2022. During this period, recorded precipitation of 132.5 mm persisted for nearly 8 hours [12,13]. The floods led to further landslides in regions characterized by steep slopes. Among the districts under consideration, Sorong (12.8%), Sorong Manoi (18.1%), and North Sorong (27.1%) had the highest prevalence of homes and individuals affected by flooding [14,15].

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The City of Sorong has enacted Regional Regulation No. 12 of 2017, which pertains to the administration of green open spaces. This regulation delineates various public areas, including parks and urban forests, road green belts, river border green belts, high voltage electricity network green belts, public cemetery parks, and nursery gardens. On the other hand, the private sector encompasses various entities such as leisure parks, residential parks, neighborhood parks for office and commercial buildings, zoos, public cemeteries supported by donations, sports fields, urban agricultural land, high voltage lines, train tracks, roof gardens, and wall gardens [16]. Nevertheless, it is imperative to revise this regulation according to the guidelines stipulated by the Minister of Agrarian Affairs and Spatial Planning/Head of the National Land Agency No. 14 Year 2022, which corresponds to establishing and utilizing green urban spaces [11].

The construction and enhancement of green infrastructure in Sorong City are primarily centered around governance, sustainable development, disaster risk reduction, and the Urban Green Open Space Development (UGOSD) initiative, all aimed at achieving the Sustainable Development Goals (SDGs 2030) and the Long-Term Strategy for Low Carbon and Climate Resilience (LTS LCCR 2050). Efforts to address climate change and hydrometeorological disasters have gained significant attention in recent years inside Indonesian territory, particularly in Southwest Papua. Implementing green enrichment measures is essential in this context [17,18,19].

This research was conducted based on the SWOT analysis to reevaluate the condition of UGOSD to meet the 30% target for anticipating climate change and hydrometeorological disasters, which have also affected Sorong City. This study analyzes the strategic and policy priorities necessary to transform the UGOSD following national goals and concurrently with Indonesia's Folu Net Sink 2030 and LTS LCCR 2050 targets. [20,21].

2. Material and methods

2.1. Study area

Sorong City is in the coordinates of 131°51' East longitude and 0° 54' South latitude. The administrative divisions of Aimas District in Sorong Regency and Salawati District in Raja Ampat Regency demarcate the southern region. To the east, it is adjacent to Sorong District in Sorong Regency, while the western boundary is defined by the Dampir Strait. According to Figure 1, the urban green space is comprised of many components, including mangrove ecosystems (4.64%), nature tourist parks (2.79%), village parks (0.92%), cemeteries (0.24%), urban forests (0.24%), green belts (0.11%), and district parks (0.05%). These components account for 8.21% of urban green space [22].

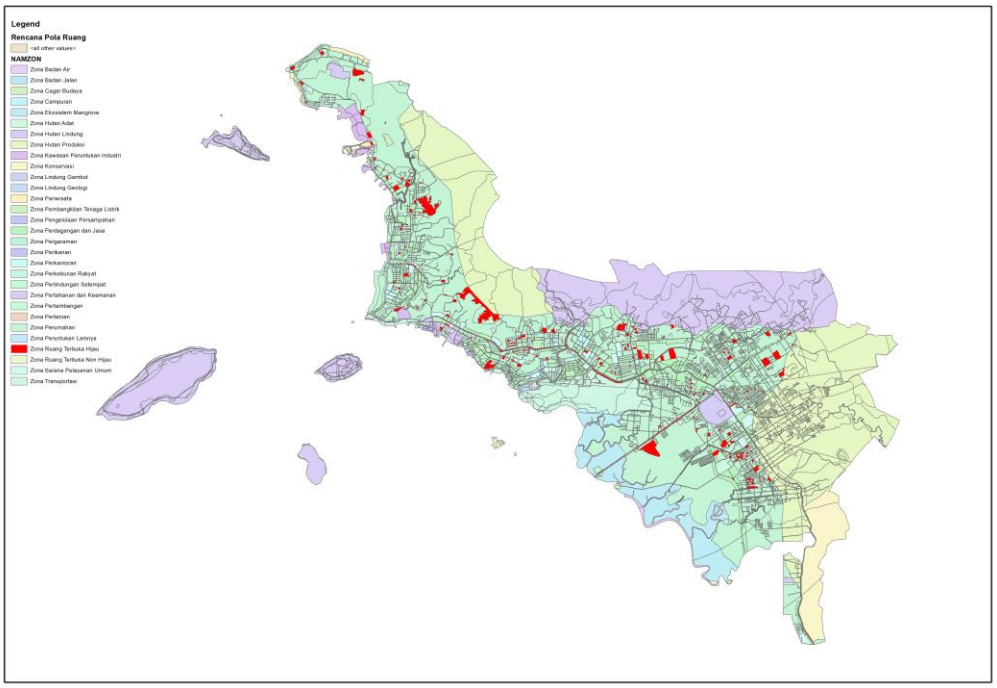

Figure 1 Map of urban green open space in Sorong City

2.2. Method of data analysis

This study is used the Slovin method [23] to gather data from a selected group of participants, utilizing the corresponding formula provided below:

$$n = \frac{N}{1+N.e^2} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

where:
The sample size required for the study is denoted as 'n', the population size is represented by 'N', and the tolerance margin of error is indicated as 'e'.

Sorong City has been designated as the location for implementing the Urban Green Open Space Development (UGOSD) initiative. The statistical analysis conducted for this project has indicated a margin of error of 5%. It is important to note that the population of Sorong City is estimated to be 289,767 individuals, as reported by the Sorong City Central Bureau of Statistics [24]. The sample size achieved for this study consists of 399 individuals. The calculations used to arrive at this sample size are as follows:

$$= \frac{289{,}767}{1 + (289{,}67(0.05)^2)}$$

$$= \frac{289{,}767}{725.42}$$

$$= 399\ people$$

Considering the assumption that each family consists of six (6) members, the dataset of 399 individuals is divided into 67 distinct families.

Out of the nine groups of respondents, 60% were representative of impacted communities, while the remaining 5% were allocated to each of the following categories: district officials, regency officials, provincial officials, village officials, community leaders, traditional leaders, women leaders, and youth leaders.

To conduct a more comprehensive study, we employ a five-point Likert scale [25] consisting of the following categories: strongly agree (SA,5), agree (A,4), neutral (N,3), disagree (D,2), and severely disagree (DS,1). The overall percentage is computed using the following formula:

$$Index\ \% = \frac{Total\ score}{Y} x\ 100\% \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad 1$$

where:

The index percentage is denoted as a numerical value expressed in percentage form. The total score represents the evaluation provided by the respondents. Meanwhile, the variable Y is calculated by multiplying the highest score by the total number of respondents.

The SWOT analysis is a methodological approach that involves the identification, examination, and evaluation of internal and external factors that may have the potential to be advantageous or disadvantageous. The acronym SWOT represents the four key elements being considered: strengths (S), weaknesses (W), opportunities (O), and threats (T). To develop the matrix of strengths, weaknesses, opportunities, and threats, it is necessary to carry out the following subsequent procedures [26,27]:

1. Identification of internal factors, which encompasses the identification of notable strengths and weaknesses. Subsequently, these factors are utilized to construct the internal factor evaluation matrix (IFE).
2. Identifying internal variables, encompassing notable opportunities and threats, is followed by creating an external factor assessment matrix (EFE).
3. Construct an internal-external matrix.
4. The weighting calculation involves using the participant's responses multiplied by the rating scale ranging from 1 to 5 (representing very low to extremely high). This process results in a score for each internal and external element.

5. The strategy recommendations are developed using the SWOT (Strengths, Weaknesses, Opportunities, and Threats) matrix.
6. To determine the most effective methods and policies, a methodology involving the application of weighing, ranking, and scoring will be employed to identify the top five options.

3. Results and discussion

3.1. Attributes of the respondent

Table 1 presents the data of respondents derived from a sample of 67 families residing in urban green spaces within Sorong City. The average family size in this sample is 6 individuals.

Table 1 The features of family data

Family Attribute (unit)	(Min-Max; Average)
Man's age (year)	33.0 – 65.0; 49.0
Woman's age (year)	25.0 – 60.0; 55.0
Man's education (year)	0.0 – 16.0; 8.0
Woman's education (year)	0.0 – 12.0; 6.0
Family unit (people)	5.0 – 7.0; 6.0
Monthly income per capita (thousand Rp)	3,500.0 – 16,000.0; 9,750.0

According to the statistics provided by the respondents, the average age of males and females falls within the productive age range of 15-64 years [28]. The analysis of educational data revealed topics that were deemed intriguing by officials. Individuals with Bachelor's degrees had a significant impact on the communities in Sorong City, as their educational background equipped them with above-average knowledge and understanding of urban green space development. The mean income derived from the advantages of urban green spaces was 9,750,000 thousand rupiahs, mostly sourced from the remuneration of public and private sector personnel, with the latter exhibiting a dominant presence in the market. On the contrary, female individuals engaged in the sale of agricultural products, including produce, have the potential to generate a monthly income of up to 3,500,000 rupiahs.

3.2. SWOT analysis

3.2.1. Internal factor

The initial stage in constructing the internal factor evaluation matrix is prioritizing the shortcomings and strengths of the UGOSD within the region of Southwest Papua Province. A survey was conducted among 30 urban environmental experts and planners to gather their perspectives. The impact or relevance was determined by identifying internal factors by administering surveys and seeking consultation with specialists. To ensure that each strength and weakness's coefficients add up to 1, a numerical value ranging from 0 to 1 is assigned to each attribute [29,30]. This enables us to assess how much the internal components are affected. Each identified internal factor was assigned a numerical value ranging from 1 to 4, where a score of 1 represented a significant weakness, a score of 2 indicated a moderate weakness, a score of 3 denoted a moderate strength, and the score of 4 represented a significant strength (31). The ultimate outcome is ascertained by multiplying the assigned weight by the corresponding rating. The weight, rank, and score of the identified internal components are presented in Table 2 [31].

3.2.2. External factor

Identifying opportunities and threats occurred during the second phase of the SWOT analysis. Southwest Papua contributed to advancing the urban green infrastructure sector by compiling expert comments, as presented in Table 3. After being found, external factors underwent the same evaluation process as internal factors to ascertain their significance and establish their relative ranking. The scores 1, 2, 3, and 4 indicated the fundamental and typical levels of comprehension [32]. Table 3 presents the weight, ranking, and final score of the most significant opportunities and risks within the domain of the UGOSD [33].

Table 2 Internal factor outcomes (strengths and weaknesses)

No	Strengths	Weight	Ranking	Score
1	Detailed Plan for Urban Spatial Planning in Sorong City	0.04	4	0.14
2	Urban Spatial Planning of Sorong City	0.03	3	0.09
3	Public green open space reached 8.21%	0.06	4	0.24
4	Regional economic expansion	0.07	4	0.29
5	Environmental and ecosystem safeguarding	0.07	3	0.20
6	Enhance economic and social performance	0.07	4	0.28
7	Cipta Karya Spatial Planning as administration of UGOSD	0.02	4	0.10
	Sub Total	**0.36**		**1.34**
No	**Weaknesses**	**Weight**	**Ranking**	**Score**
1	Regional and geographical variations	0.06	2	0.12
2	Not included in low-carbon development planning yet	0.04	1	0.04
3	Haven't considered climate resilience	0.07	2	0.13
4	The saturation level of roads is quite high - high (D-F)	0.07	1	0.07
5	Air pollution	0.07	2	0.14
6	Noise pollution	0.07	1	0.07
7	Road user inconvenience	0.06	1	0.06
8	Discomfort for roadside pedestrians	0.06	2	0.12
9	Weak coordination between the parties	0.07	2	0.14
10	Ineffective supervision in urban development	0.07	2	0.14
	Sub Total	**0.64**		**1.04**
	Total	**1.00**		**2.38**

Table 3 External factor outcomes (opportunities and threats)

No	Opportunities	Weight	Ranking	Score
1	A hospitable environment and climate resilience for the community	0.06	4	0.22
2	Cleaning fees	0.03	3	0.09
3	Increase public understanding of the importance of being environmentally	0.05	4	0.21
4	Road congestion due to easy access to vehicle credit	0.04	3	0.13
5	Smooth weather-related information	0.03	3	0.10
6	Reducing urban heat islands	0.06	4	0.24
7	Optimization of public and private land	0.03	4	0.13
8	Increasing community participation	0.06	3	0.18
	Sub Total	**0.36**		**1.28**
No	**Threats**	**Weight**	**Ranking**	**Score**

1	Extreme hydrometeorological catastrophe	0.06	2	0.12
2	Disaster Risk Index is significantly elevated	0.06	2	0.11
3	Mangroves and other green spaces have been destroyed	0.06	2	0.12
4	Road drainage system was compromised at multiple locations	0.06	1	0.06
5	Climate change difficulty	0.05	1	0.05
6	Low traffic density	0.06	1	0.06
7	Boosting district and provincial economic expansion	0.05	1	0.05
8	Enhancing community amenity facilities and infrastructure	0.06	1	0.06
9	Participation of the community is limited to the implementation phase	0.06	2	0.12
10	Funds for supplying green open space are not well-planned	0.06	2	0.12
11	Green open-space institutions are not currently accessible	0.06	2	0.12
	Sub Total	**0.64**		**0.99**
	Total	**1.00**		**2.27**

3.2.3. Assessment of the current state of the UGOSD system

After completing this phase of SWOT implementation, a desired scenario will be selected from the four available options (aggressive, competitive, conservative, and defensive), and suitable strategies for improving the UGOSD in Southwest Papua will be presented [34]. In an alternative manner of expression, we can employ the respective matrices to evaluate and compare internal and external factors. The current condition of the urban green infrastructure in Southwest Papua can be delineated by employing an evaluation matrix. The vertical dimension of the matrix is used to place the final scores acquired from the internal factor assessment matrix. In contrast, the horizontal dimension places the final scores gained from the external factor assessment matrix. This matrix construction allows for determining the status of the urban green infrastructure system and selecting the most effective strategies. The matrix above resembles a strengths, weaknesses, opportunities, and threats (SWOT) analysis. It provides a comprehensive overview of the most effective ways to enhance the urban green infrastructure [35].

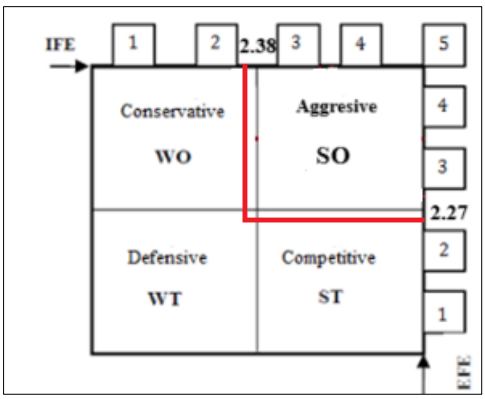

Figure 2 SWOT implementation quadruple situations

The determination of the UGOSD system's ranking was achieved through the subtraction of the combined scores from both the internal and external factor matrices. According to Table 3, the cumulative score for the external elements is 2.27, whereas Table 2 indicates that the cumulative score for the internal components is 2.38. Figure 2 illustrates the matrices representing the internal and external factors and their respective scores. According to Figure 2, it can be observed that the UGOSD system is presently in a stable state. It is imperative to acknowledge that the urban green infrastructure system is inside a defensive domain when the Internal Factor Evaluation (IFE) score is below 2.5, and the External Factor Evaluation (EFE) score is below 2.5. The urban green infrastructure system in Southwest Papua is characterized as defensive, as shown by an Internal Factor Evaluation (IFE) score of 2.38 and an External Factor Evaluation (EFE) score of 2.27. Consequently, strategic strategies can be employed to mitigate internal weaknesses and potential threats, ensuring the survival and resilience of the system [36,37].

Table 4 Principal UGOSD system strategies in Southwest Papua

Internal	**External**
Threats	**Weaknesses**
Extreme hydrometeorological catastrophe	Regional and geographical variations
Disaster Risk Index is significantly elevated	Not included in low-carbon development planning yet
Mangroves and other green spaces have been destroyed	Haven't considered climate resilience
Road drainage system was compromised at multiple locations	The saturation level of roads is quite high - high (D-F)
Climate change difficulty	Air pollution
Low traffic density	Noise pollution
Boosting district and provincial economic expansion	Road user inconvenience
Enhancing community amenity facilities and infrastructure	Discomfort for roadside pedestrians
Participation of the community is limited to the implementation phas	Weak coordination between the parties
Funds for supplying green open space are not well-planned	Ineffective supervision in urban development
Green open space institutions are not currently accessible	**Strategies (WT)**
	WT1. The reduction of climate change and natural disasters by increasing open space by 30 %
	WT2 Enhancement of the local population's economic growth
	WT3 Enhancement of infrastructure and facilities
	WT4 Enhancement of community participation in the management and maintenance
	WT5 Increased funding from all parties.

Adopting a cautious stance, WT techniques offer the most potential for enhancing the UGOSD system. Thus, the primary objective of the defensive strategy is to utilize existing weaknesses and threats to strengthen the urban green infrastructure system from within. Consequently, Table 4 illustrates the defensive strategies derived from the intersection of the urban green space system's weaknesses and threats in Southwest Papua. To identify 110 WT tactics, managers and city environmental planners combined 10 weakness variables with 11 threat factors. However, the majority of these hybrid strategies were not particularly alluring. The stakeholder planners in Southwest Papua have chosen 6 viable WT solutions to improve the UGOSD (Table 4) [38,39]. The strategy recommendations entail addressing climate change and disaster reduction by implementing various measures. These include expanding green open spaces by up to 30%, fostering local community economic growth within these areas, enhancing facilities and infrastructure in green open spaces, promoting community involvement in the maintenance of such spaces, allocating increased budgetary resources for the upkeep of green open spaces, and establishing institutions dedicated to the management of these areas. Numerous studies also advocate for the active participation of multiple stakeholders through the allocation of financial resources to bolster the Urban Green Open Space Development (UGOSD) initiative. This approach aims to enhance ecological functions, water retention capabilities, economic viability, social and cultural dimensions, aesthetic appeal, and disaster management efforts [40,41,42].

4. Conclusion

A comprehensive SWOT analysis was conducted to derive strategy and policy development from strategy IV, yielding IFE and EFE values of 2.38 and 2.27, respectively. Hence, formulating policies and strategies for the UGOSD system in Southwest Papua Province can be described as a comprehensive defensive approach.

This study utilized a combination of 10 weakness variables and 11 threat factors to uncover a total of 110 techniques related to weakness-threat (WT) analysis. Nevertheless, managers and city environmental planners delineate 6 key strategies around expanding green open spaces by a maximum of 30%. These tactics encompass fostering local community economic growth within these areas, improving the facilities and infrastructure in green open spaces, encouraging community participation in maintaining such spaces, allocating additional financial resources for their upkeep, and establishing specialized institutions responsible for their management.

The cultivation of elements inside the UGOSD has garnered significant attention because of its anticipated crucial role in establishing urban green infrastructure as a model in Eastern Indonesia. This aligns to achieve Indonesia's Folu Net Sink 2030 and LTS LCCR 2050.

Compliance with ethical standards

Acknowledgments

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Disclosure of Conflict of Interest

There is no conflict of interest.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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