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Towards sustainable development of urban green space framework in Sorong City, Southwest Papua Province, Indonesia

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Abstract

Sustainable development, including efforts to reduce greenhouse gas emissions and strengthen communities' ability to recover back from natural disasters, should inform any increase in urban green space. This study used a survey and interview design based on the Slovin technique and the Likert scale to collect data from members of the impacted community and district, regency, provincial, village, community, traditional, women's, and youth leaders. When asked to rate a sustainable development SDUGS framework, respondents gave 35.25% and 34.29%, respectively, to environmental and social indicators. The next two groups of variables, economic and institutional, came in at 23.84% and 6.62%. Therefore, the respondents endorse the program for the sustainable development of the urban green space model in Sorong City, Southwest Papua Province, with a satisfactory category in the environmental, social, and economic perceptive and a category lacking in institutions whose performance needs to be improved, all in an effort to be in line with the transformation of the Long-Term Strategy for Low Carbon and Climate Resilience by 2050.

Keywords: Urban Green Space; Environment; Social; Economic; Institutional; Low Carbon; Climate resilience

1. Introduction

There is a quota of urban green space that must be met by the Sorong City Government of 30%, of which 20% must be publicly owned and 10% must be privately maintained [1,2,3]. Only 8.21% of Sorong's land area has been developed into public green open spaces, necessitating an additional 12% in new additions and 10% in private additions [4,5,6,7].

Several areas of Sorong City have experienced flooding and landslides as a result of the poor condition of the city's green space, resulting in the deaths of a number of people and the destruction of dozens of homes. Along with climate change and extreme weather from the north coast of Sorong City, which was traversed by tropical cyclones, on August 22-23, 2022, extreme rainfall reached 132.5 mm and lasted approximately 8 hours [8,9]. The floods that occurred caused subsequent landslides in areas where the slopes were extremely precipitous. Sorong (12.8%), Sorong Manoi (18.1%), and North Sorong (27.1%) were the 10 districts with the highest proportion of households and individuals experiencing flooding [10,11].

The City of Sorong already possesses Regional Regulation No. 12 of 2017 regarding the management of green open spaces, which specifies that public areas consist of parks and urban forests, road green belts, river border green belts, high voltage electricity network green belts, public cemetery parks, and nursery gardens. In contrast, the private sector consists of recreational parks, residential parks, office and commercial building neighborhood parks, zoos, public cemeteries funded by donations, sports fields, urban agricultural land, high voltage lines, railroad tracks, roof gardens, and wall gardens [12].

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Internal factors in terms of strengths indicate that efforts to increase the quantity and/or quality of urban green space are necessary to realize the area's potential and should be accompanied by the addition of facilities, utilities, and aesthetic elements. Efforts to increase urban green space are intended to benefit research, education, and outreach facilities, active and passive recreation facilities, means of increasing the economic value of urban land, means of fostering a sense of pride and increasing regional prestige, social activity opportunities for city residents, and evacuation facilities [13, 14, 15, 16].

In an effort to overcome the problems and threats from climate change and disasters, the development of the concept of sustainable urban green space is essential to the implementation of an integrated environmental, socio-cultural, economic, and institutional basis, which is also included in the pillars of sustainable development goals in the Land of Papua and supports the achievement of the Long Term Strategy for Low Carbon Development and Climate Resilience 2050 [17,18].

2. Material and methods

2.1. Study area

Geographically, Sorong City is located at the following coordinates: 131°51' East longitude and 0° 54' South latitude. The south is bounded by Sorong Regency (Aimas District) and Raja Ampat Regency (Salawati District), the east is bordered by Sorong Regency (Sorong District), and the west is bordered by the Dampir Strait. Mangrove ecosystems (4.64 %), nature tourism parks (2.79 %), village parks (0.92 %), cemeteries (0.24 %), urban forests (0.24 %), green belts (0.11 %), and district parks (0.05 %) make up 8.21% of the urban green space represented in Figure 1 [19].

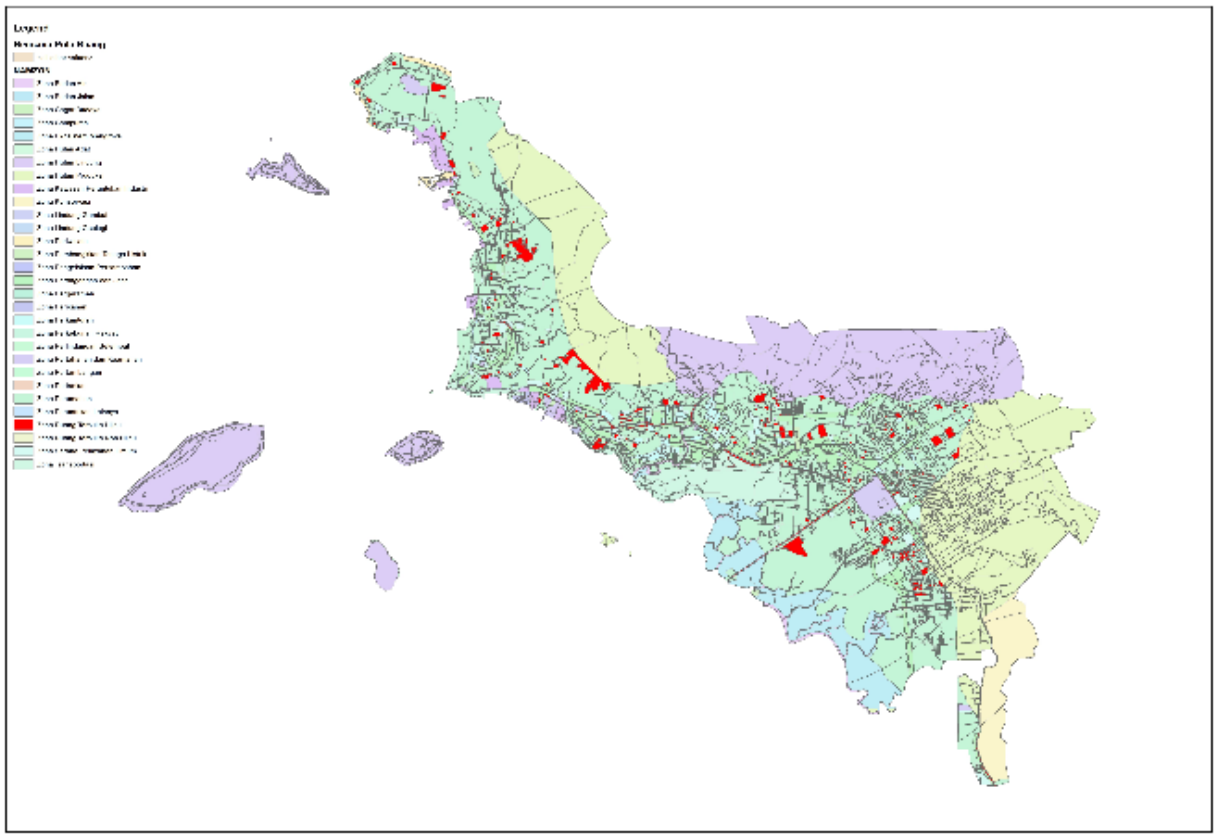

Figure 1 Urban green space in Sorong City

2.2. Method of data analysis

This study collects data from a sample of respondents using the Slovin method [20] and the accompanying formula:

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

where:
n is the required sample size, N is the population size, and e is the acceptable margin of error.

Sorong City is the site for green open space, with a margin of error of 5% and a population of 289,767 persons [19]. The obtained sample size is 399 persons, and the computations are as follows:

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

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

$$= 399\ people$$

Assuming that each family has six (6) members, the data sample of 399 people is segmented into 67 families.

60% of the nine respondent groups were from affected communities, while 5% were from each of the following categories: district, regency, and provincial official, village official, community leader, traditional leader, women leader, and youth leader.

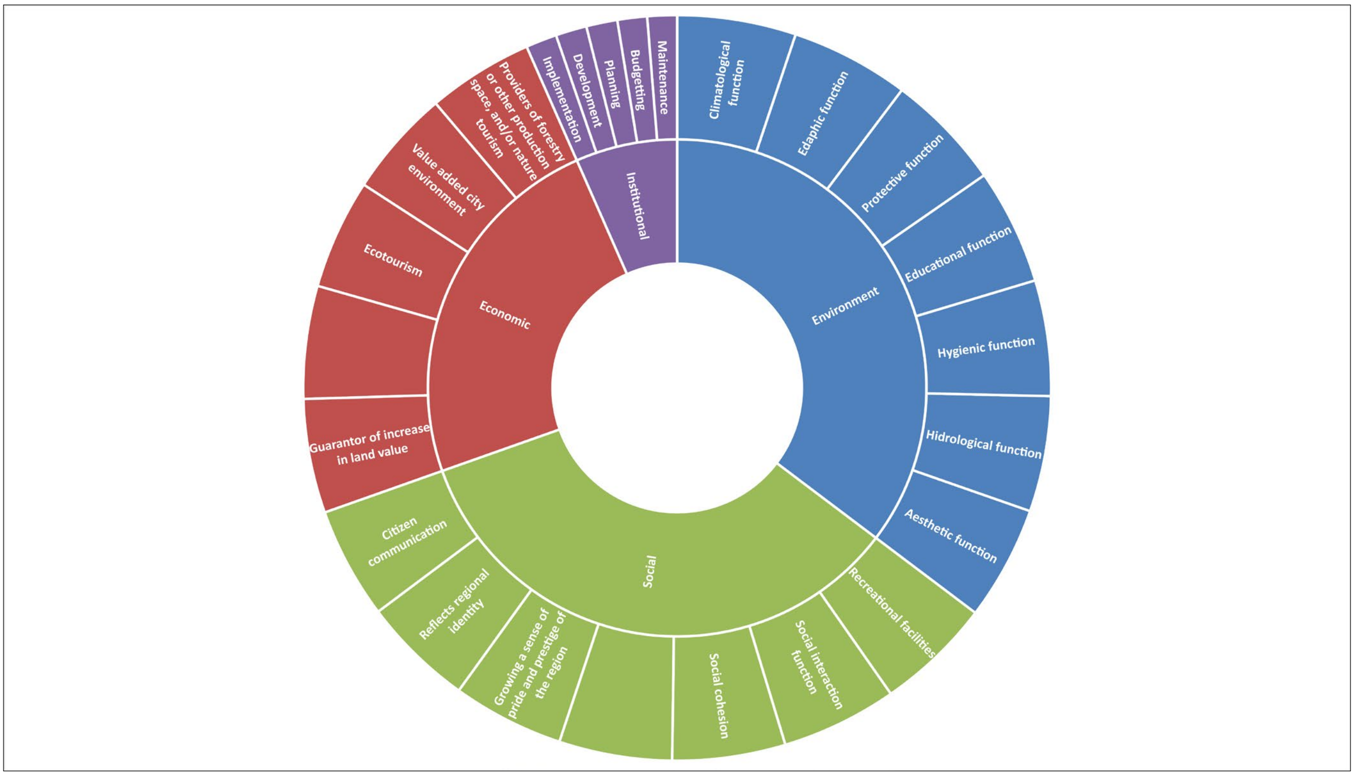

Figure 2 Southwest Papua’s sustainable development of urban green space framework

The Sustainable Development of Urban Green Space (SDUGS) Framework is also used for analysis, as well as for best practices, lessons learned, and initial information in natural resource management based on sustainable development objectives, with a primary focus on the four assessment pillars: environment, social-cultural, economics, and institutions (Figure 2) [21,22,23,24].

For further analysis, we utilize a five-point Likert scale [25] with the following categories: strongly agree (SA,5), agree (A,4), neutral (N,3), disagree (D,2), and severely disagree (DS,1); the total percentage is calculated as follows:

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

where:
Index% is expressed as a percentage (%), Total score is the evaluation from respondents, and Y is the highest score multiplied by the total number of respondents.

3. Results and discussion

3.1. Features of the respondent

Table 1 provides respondent data from 67 families, with an average of 6 people per family, in urban green space areas in Sorong City.

Table 1 Characteristics of Respondents

Family Features (unit)	**(Min-Max; Average)**
Age of Man (year)	33.0 – 65.0; 49.0
Age of Woman (year)	25.0 – 60.0; 55.0
Education of Man (year)	0.0 – 16.0; 8.0
Education of Woman (year)	0.0 – 12.0; 6.0
Family membership (people)	5.0 – 7.0; 6.0
Income/capita/month (thousand Rp)	3,500.0 – 16,000.0; 9,750.0

The mean age of males and women according to the respondent's data falls within the productive age group (15-64 years) [26]. The educational data uncovered items that officials found to be intriguing. They influenced communities in Sorong City with Bachelor's degrees, so their knowledge was above average and they understood how to construct urban green space. The average income obtained from the benefits of urban green space was 9,750,0 thousand rupiahs, which was obtained from the salaries of civil servants until private employees dominated the market. In contrast, women who sell produce and other agricultural goods may earn up to 3,500,000 rupiahs per month.

3.2. Perceptive Environment of SDUGS

Descriptive frequencies of smart environmental benchmarks of SDUGS data for the 7 questions can be viewed in Table 2. The table illustrates the need for further research to incorporate issues such as selecting aesthetic function (Env_7), educational function (Env_6), hygienic function (Env_5), and hydrological function (Env_2). While other indicators such as the edaphic function (Env_1), climatological function (Env_3), and protective function (Env_4) have been understood by the respondents.

Table 2 illustrates that the Skewness and Kurtosis ratios for Env_1 - Env_7 successively are -1.02 , -1.88; -0.44 , -1.33; -1.07 , -1.755; -0.70 , -1.72; -0.50 , -1.57; -0.48 , -1.90; and -0.32 , -1.93 which lies between the values -2 to 2, showing the data is spread uniformly [27].

SDUGS Framework awarded the highest aggregate score of 35.25% to the opinions of community members on the smart environment. The three primary categories of these components: treatment (42.39%), ecology (28.90%), and safety (28.72%) are displayed in Figure 3. The percentage of respondents who responded to each query using the Likert scale can be recognized in Figure 4.

Sorong City has experienced multiple floods, the worst of which occurred on 22-23 August 2022, so efforts are required to increase urban green space by focusing on absorption areas in the upstream watershed and rainwater harvesting technology by creating biopores and drainage, which must be improved by focusing on volume with an emphasis on increasing width and length [28,29]. Furthermore, this urban green space helps to combat harsh dry temperatures by

acting as a safety net by providing shade when the air temperature is high, as well as a savior of soil nutrients and water availability [30,31]. The approach to treatment described above is an indicator of safety in low-carbon development and increased community resilience.

According to the respondents, the treatment grouping has the highest portion in the capable environment, with sanitary, educational, and aesthetic benefits. Aside from aesthetic considerations, it is also vital to focus on selecting plants with high energy calorific values that can be used as pelleted biomass to meet human energy demands sustainably [32,33].

Table 2 Statistical analysis of perceptive environmental

Descriptive Statistics									
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**	**Skewness**		**Kurtosis**	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Env_1	67	3	5	4.18	0.737	-0.298	0.293	-1.088	0.578
Env_2	67	3	5	4.10	0.677	-0.129	0.293	-0.768	0.578
Env_3	67	3	5	4.19	0.723	-0.313	0.293	-1.014	0.578
Env_4	67	3	5	4.13	0.716	-0.204	0.293	-0.996	0.578
Env_5	67	3	5	4.10	0.699	-0.146	0.293	-0.905	0.578
Env_6	67	3	5	4.09	0.733	-0.142	0.293	-1.097	0.578
Env_7	67	3	5	4.06	0.736	-0.095	0.293	-1.117	0.578
Valid N (listwise)	67								

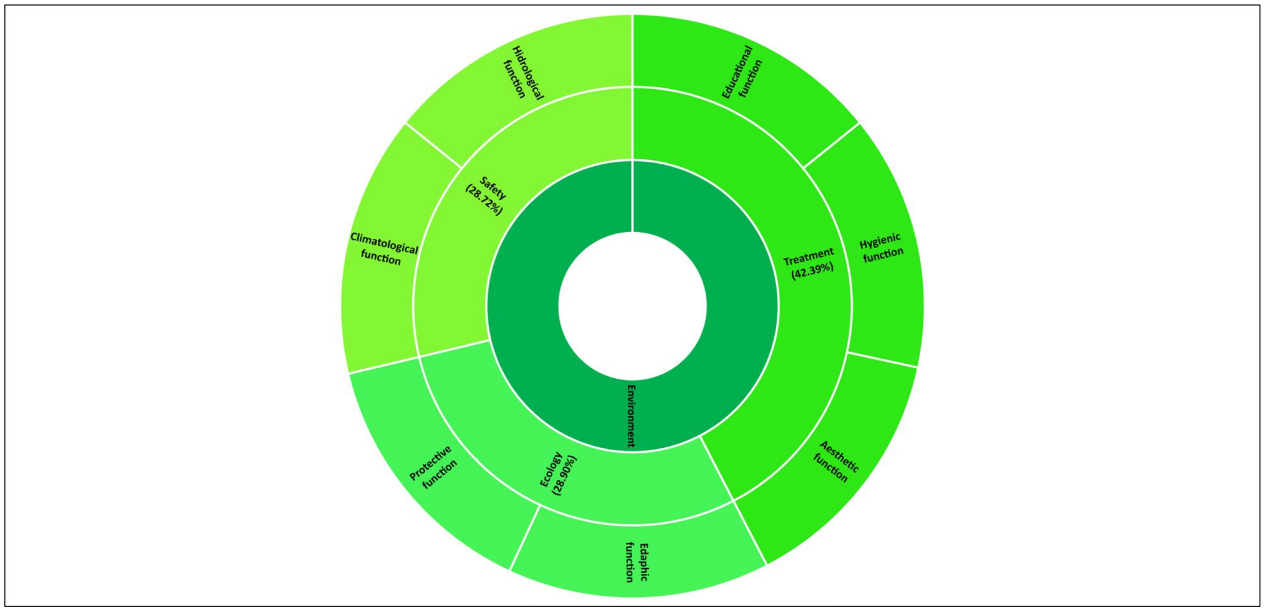

Figure 3 Perceptive environmental factors

In order to increase urban green space to 20% for the public, efforts must be made to enter the protected forest in Sorong City by coordinating with the parties and determining 10% for the private sector through plantations in collaboration with private housing developers and the community. Multiple real estate selling points have been improved by urban green housing construction in major metropolitan areas [34,35].

Respondents indicated that the environmental factor with the most frequent response was highly congruent with the variables of the edaphic and climatological functions. While the majority of responses are in the concur category (43–51%), the remaining responses are neutral (19–24%) (Figure 4). This demonstrates that the community understands the effects of climate change and has been impacted by flooding, increasing their awareness and desire to improve conditions collectively by restoring a deforested and degraded environment [36,37].

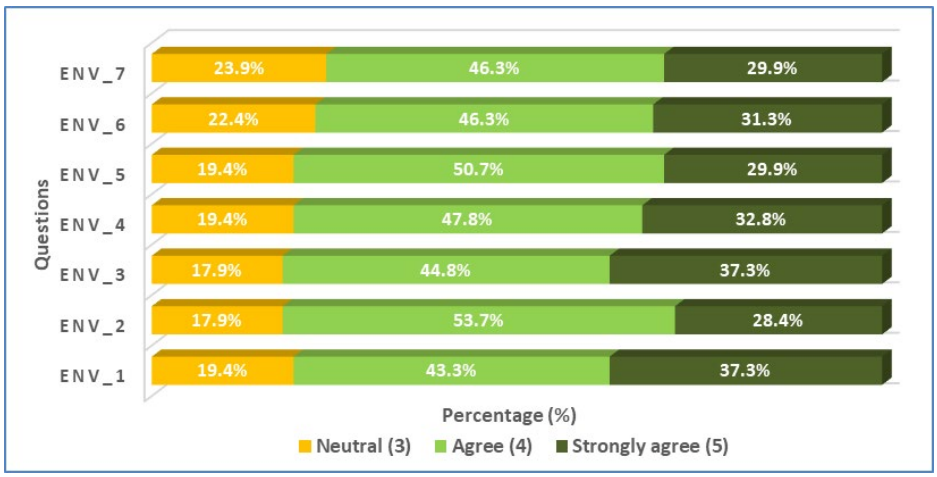

Figure 4 Percentage of responses to environmental factors

3.3. Perceptive Social of SDUGS

The mean statistical values in Table 3 provide that in terms of social elements, the values that need to be improved include reflecting regional identity (Soc_5), growing a sense of pride and prestige in the region (Soc_6), and social cohesion (Soc_7). This is partially because immigrant communities frequently use urban green space. Other social components, such as the social interaction function (Soc_1), citizen communication (Soc_2), education, fun, health, and social interaction (Soc_3), and recreational facilities (Soc_4), are already operational and well used.

Perceptive social may be concluded that the data is normally distributed because the Skewness and Kurtosis ratio values, calculated using the standard error for each of the seven variables Soc_1 through Soc_7, fall within the range of -2 to 2 (Table 3).

Table 3 Statistical analysis of perceptive social

Descriptive Statistics									
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**	**Skewness**		**Kurtosis**	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Soc_1	67	3	5	4.12	0.729	-0.188	0.293	-1.069	0.578
Soc_2	67	3	5	3.96	0.787	0.080	0.293	-1.369	0.578
Soc_3	67	3	5	4.01	0.728	-0.023	0.293	-1.075	0.578
Soc_4	67	3	5	4.12	0.769	-0.209	0.293	-1.156	0.578
Soc_5	67	3	5	3.93	0.681	0.093	0.293	-0.788	0.578
Soc_6	67	3	5	3.96	0.614	0.023	0.293	-0.246	0.578
Soc_7	67	3	5	3.99	0.639	0.012	0.293	-0.464	0.578
Valid N (listwise)	67								

The social component of the SDUGS Framework ranks second with 34.29%, lagging only the perceptual environment component. Beyond that, Figure 5 depicts how these elements are divided into a couple of key categories: development (57.04%) and lifestyle (42.96%). Figure 6 illustrates simultaneously the proportion of respondents who answered specific Likert scale questions.

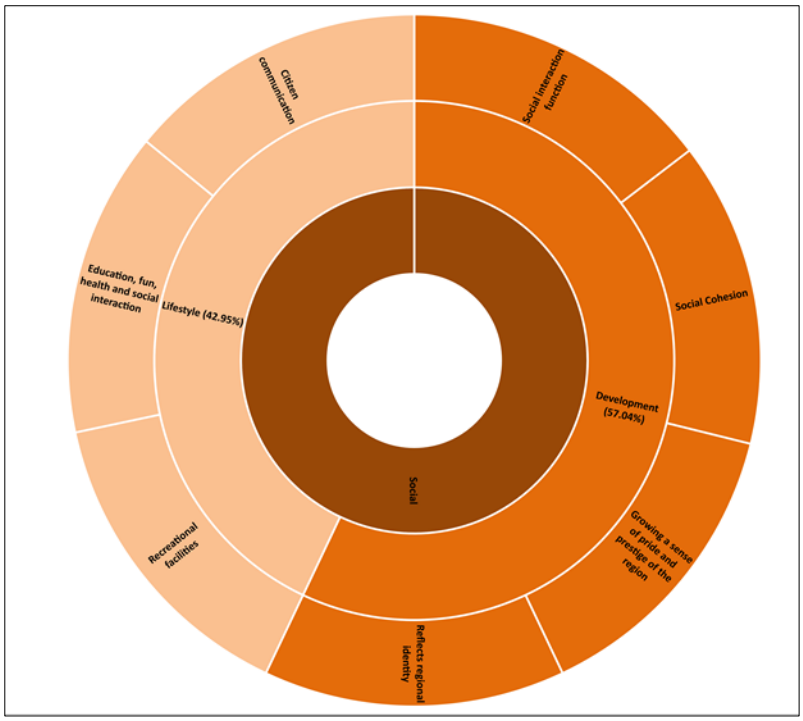

Figure 5 Perceptive social factors

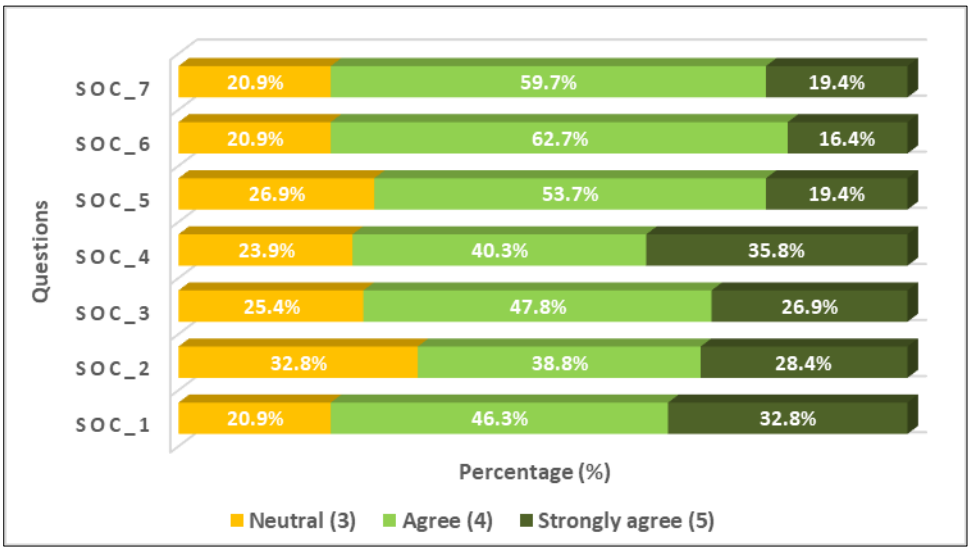

Figure 6 Percentage of responses to social factors

Those who are already overworked and stressed should be able to gain advantages from the results of the community opinion survey by taking into account the lifestyle factor of increased public quality of life, which is indicated by environmental sustainability and surrounding comfort with nice temperature [38,39].

Improving public health and the aesthetic value of neighborhoods are also important goals of the innovative social component development process. Due to the existing state of affairs and the lack of available urban green space, the cityscape is mostly deficient in its aesthetically pleasing qualities. During the Covid-19 outbreak, finding wide, green

spaces to breathe in healthy, purified air was difficult. Therefore, people only stay at home when they're in a state of intense tension or anxiety [40,41].

As in innovative green cities in several cities in Indonesia and abroad, respondents should prioritize stress management, increased communication, relationships, teamwork, and comfort for the advantage of the local community's social benefits, and they should also pay important attention to the development of city width.

3.4. Perceptive Economic of UGIR

The distribution of economic descriptive data and economic indicators for the five questions can be examined in Table 4. These results demonstrate the need for additional research on issues related to the value-added city environment (Eco_2) and purveyors of forestry or other production space, as well as nature tourism (Eco_3). In contrast, other issues have already garnered the attention of respondents comprising the guarantor of increase in land value (Eco_1), value-added city environment (Eco_4), and providers of forestry or other production space, and/or nature tourism (Eco_5).

The results of data distribution based on the Skewness and Kurtosis ratios in Table 4 fall between -2 and 2, indicating that the obtained economic data for each of the five variables Eco_1 through Eco_5 is normally distributed.

Table 4 Statistical description of perceptive economic

Descriptive Statistics									
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**	**Skewness**		**Kurtosis**	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Eco_1	67	3	5	4.07	0.703	-0.105	0.293	-0.927	0.578
Eco_2	67	3	5	3.81	0.701	0.289	0.293	-0.912	0.578
Eco_3	67	3	5	3.73	0.665	0.362	0.293	-0.733	0.578
Eco_4	67	3	5	4.00	0.696	0.000	0.293	-0.883	0.578
Eco_5	67	3	5	3.91	0.668	0.103	0.293	-0.703	.0578
Valid N (listwise)	67								

Smart economics is placed third in the UGIR Framework with a value of 23.84%, fragmented into two crucial components: financial technologies (60.77%) and industry (39.23%), as shown in Figure 7. Figure 8 additionally indicates the percentage of each question based on the responses of the respondents.

One factor that must be taken into account while developing sustainable financial technologies is the least input in accurate and efficient technology. Working with academics is essential in order to construct urban green space that is appropriate for the species, soil requirements and texture, and that incorporates the technology needed to adapt to climate change and catastrophe mitigation (both of which are discussed at length in the technical component) [42].

The business sector for expanding green areas in cities is still in the beginning stages. To yet, only a small number of indigenous communities without official backing from the local government have established ecotourism. However, there are a number of non-governmental organizations (NGOs) that aid in the enhancement of these tourist sites so that they could have a more significant economic impact. While relocating protected areas and planting in open places, it is hoped that the eco-tourism development would serve as a catalyst for several other possible locations [43,44].

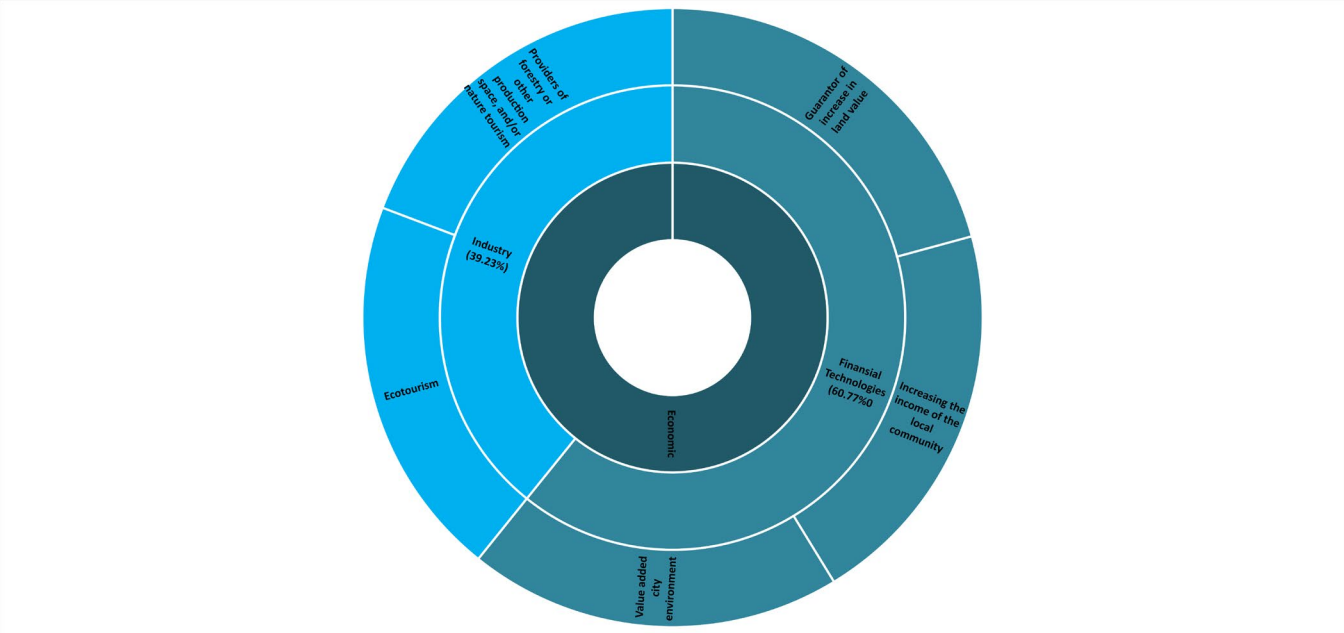

Figure 7 Perceptive economic factors

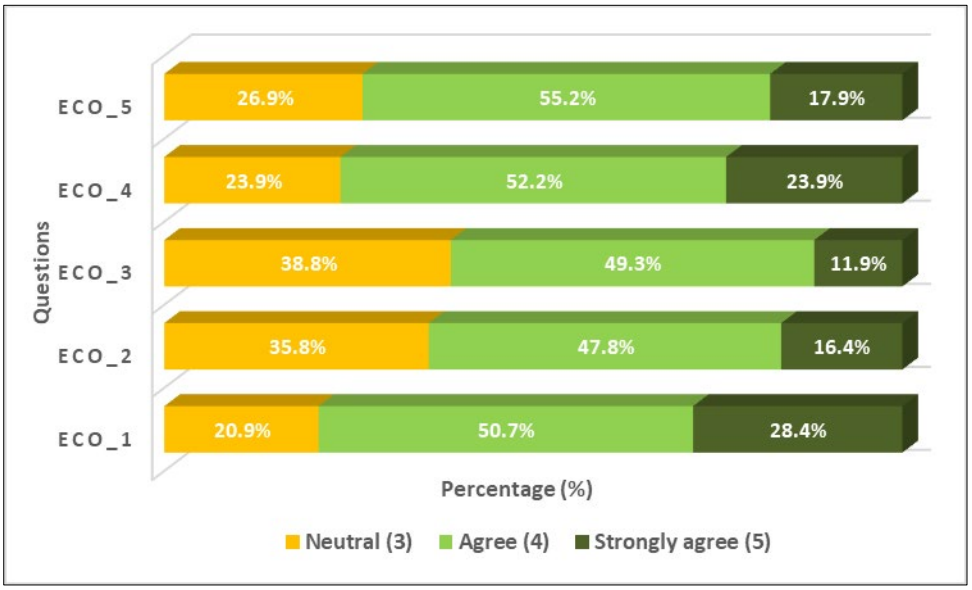

Figure 8 Percentage of responses to economic factors

3.5. Perceptive Institutional of SDUGS

Table 5 provides the question frequencies for the institutional indicator questionnaire. The findings indicate that more work is required to answer some of the problems around the execution group's budgeting processes (Inst_5). This is because many of the removed areas haven't received adequate funding for maintenance (Inst_4), and replanting. Other criteria, such as planning (Inst_1), development (Inst_2), and execution (Inst_3), indicate that it has been completed but is still not ideal, as seen by a low average value.

Perceptive institutional is the final component of the SDUGS Framework to enhance urban green quality in Sorong City, with a percentage of 6.62% divided into two components, namely strategic (61.11%) and execution (38.89%), as expressed in Figure 8. For more details on percentage responses to institutional indicator queries, recognize Figure 9.

The calculation of the Skewness and Kurtosis ratios on the institutional factor for Inst_1 through Inst_5 yields values between -2 and 2, indicating that the data is normally distributed (Table 5).

Table 5 Statistical description of perceptive institutional

Descriptive Statistics									
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**	**Skewness**		**Kurtosis**	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Inst_1	67	1	2	1.09	0.288	0.412	0.293	0.854	0.578
Inst_2	67	1	2	1.12	0.327	0.402	0.293	0.883	0.578
Inst_3	67	1	2	1.10	0.308	0.457	0.293	0.153	0.578
Inst_4	67	1	2	1.04	0.208	0.504	0.293	0.846	0.578
Inst_5	67	1	2	1.06	0.239	0.502	0.293	0.840	0.578
Valid N (listwise)	67								

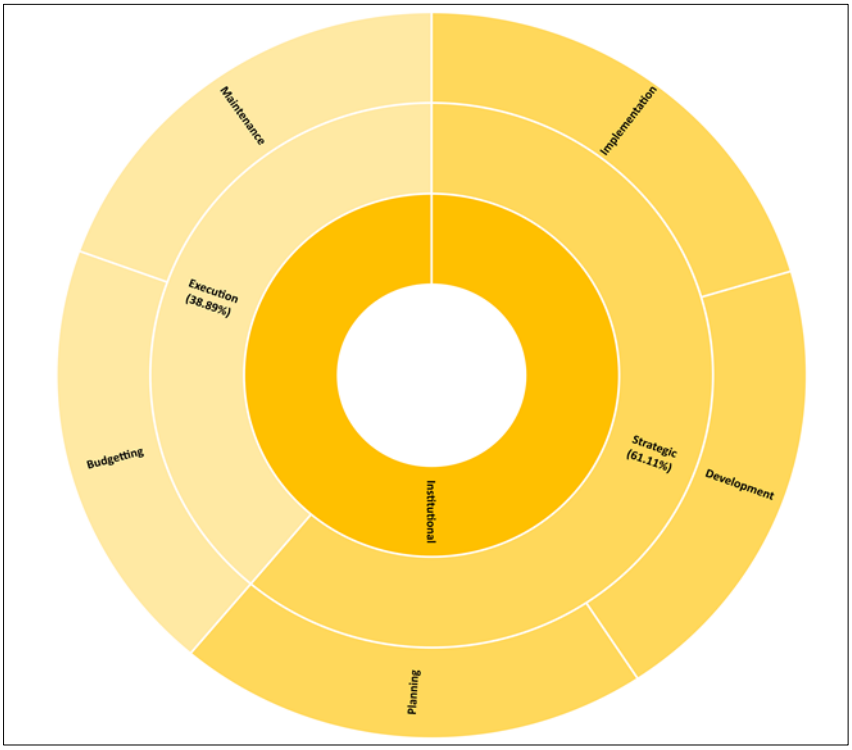

Figure 9 Perceptive institutional factors

The Sorong City Environment Service is responsible for maintaining urban greenery, while the Remu Ransiki River Basin Management Office of West Papua Province, the Sorong City Agriculture Service, and the West Papua Province Natural Resources Conservation Agency work together to cover the costs of new construction and planting. Currently, the Sorong City Regional Development Planning Agency is in charge of the city's budget, while the Cipta Karya Spatial Planning handles planning. Numerous parties are involved in the administration of this urban green space, but it is not well integrated, so respondents have given it the lowest rating (Figure 10). To achieve the goal of increasing urban green space by 30% in Sorong City, a collaboration between local institutions, including the City, Province, Center, private sector, local university, non-governmental organizations, and community is crucial developed to support Long-Term Strategy for Low Carbon and Climate Resilience (LTS LCCR) 2050 [45,46,47,48].

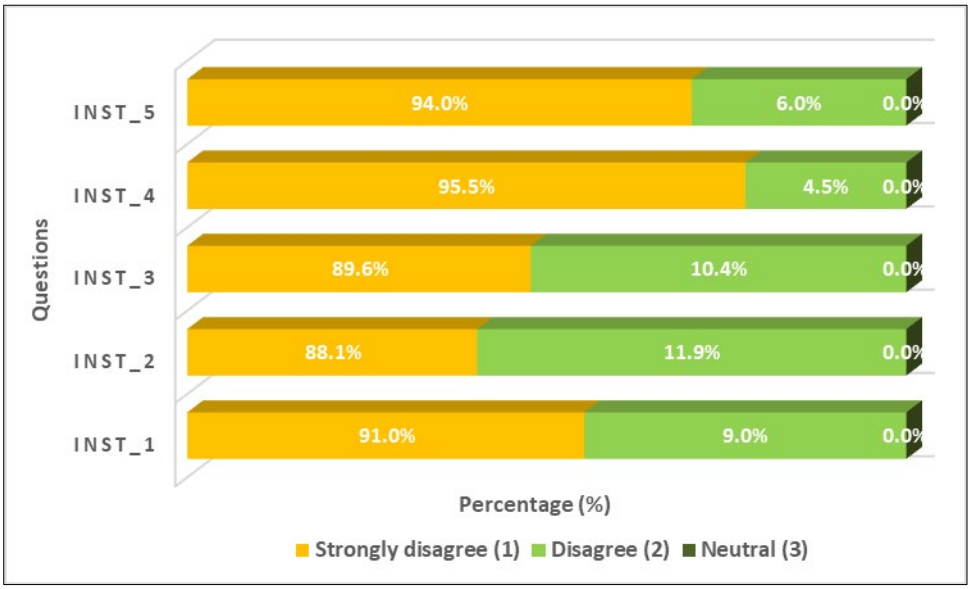

Figure 10 Percentage of responses to institutional factors

4. Conclusion

The majority of respondents are in favor of increasing the amount of green space in urban areas by the minimum required (30%), and they place extra importance on the creation of the Sorong City SDUGS Framework, which prioritizes environmental initiatives (35.25%) over social (34.42%), economic (23.84%), and institutional (6.62%).

According to the results of the questions presented to respondents, each indicator has a positive link with the development of the SDUGS framework, with some questions that require future development with local universities and the other parties in constructing green urban in Sorong City, Southwest Papua Province.

There has been a lot of focus on sustainable development's expanding components because of the vital role they are expected to play in complementing the LTS LCCR 2050 goal of establishing Southwest Papua's SDUGS Framework as a model throughout Eastern Indonesia.

Compliance with ethical standards

Acknowledgements

The authors are grateful to everyone who participated in the interviews, data collection, and discussions that helped them fill out the variables of Southwest Papua's SDUGS Framework. Special thanks go to the heads of the Sorong City Regional Development Planning Agency, the Sorong City Spatial Planning Department in Cipta Karya, and the Sorong City Environment Agency.

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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