OriginalResearchArticle

AssessmentandPlanningGreenOpenSpacesofKisaranTimurforSustainableUrban Development

Abstract

The provision of Green Open Space (GOS) in Kisaran Timur Subdistrict remains below national standards, with only 81.46 hectares recorded in 2023, representing a modest increase from 71.58 hectares in 2013. However, this growth is overshadowed by the expansion of built-up areas, which increasedby141.50hectaresduringthesameperiod.ThisstudyevaluatesthecurrentstateofGOS, calculates the subdistrict's GOS requirements based on area and population projections, and identifiesoptimallocationsforfuturedevelopment.ThefindingsrevealthatKisaran Timurrequiresa minimum of 522.64 hectares of GOS, equivalent to 20% of the total area, as mandated by Law No. 26of2007.By2043,theprojectedpopulationof122,421willnecessitate244,842m²ofpublicGOS, yet only two villages—Selawan and Siumbut Baru—currently meet these requirements. Spatial analysis using GIS identifies Mutiara Village as the most suitable location for subdistrict park development, offering the largest vacant land and highest serviceable population. The study emphasizes the urgent need for strategic planning and collaborative management to address GOS deficits,ensureequitabledistribution,andpromoteecologicalandsocialbalanceinurbanareas.The results provide a valuable framework for policymakers to enhance urban sustainability through targeted GOS development.

Keywords:GreenOpenSpace,urbanplanning,sustainabledevelopment,spatialanalysis,KisaranTimur Subdistrict.

I. Introduction

Urban areas play a strategic role in supporting economic, social, and cultural activities. Effective and sustainable spatial planning is essential to maintaining the quality of life for urban residents (FAO, 2020). One critical aspect of spatial planning is the provision of Green Open Spaces (GOS), which serve as water catchment areas, microclimate regulators, carbon dioxide absorbers, and public recreational spaces(ForestServicePublications,2003;MinistryofAgriculture,2023).However,rapidurbanizationand insufficient planning frequently threaten the existence and effectiveness of GOS (Hakim & Utomo, 2004).

The provision of GOS in Indonesia is governed by Law Number 26 of 2007 on Spatial Planning, which mandates a minimum allocation of 30% of the total urban area, comprising 20% public GOS and 10% private GOS. Despite these regulations, many regions, includingAsahan Regency, struggle to meet thesestandards.Forinstance,whiletheRegionalSpatialPlan(RTRW)ofAsahanRegencyfor2013–2033 plans a 30% GOS allocation, specific locations remain undetermined, and the lack of a Detailed Spatial Plan (RDTR) further exacerbates the situation (Dinas PUPR Kabupaten Humbang Hasundutan, 2023; Bappenas, 2021).

KisaranTimurSubdistrict,partofthecapitalofAsahanRegency,facessignificantchallengesfrom rapid population growth and urban development. Between 2013 and 2023, the population increased from 70,415 to 85,596, with density rising from 1,809 people/km² to 2,837.33 people/km² (BPS, 2023). This growthdrivesextensiveresidentialandinfrastructuredevelopment,oftenattheexpenseofGOS(Nasution

&Siregar,2023).Furthermore,KisaranTimurlagsbehindKisaranBarat,whichhasmoredevelopedpublic green spaces, such as urban forests and squares (Ministry of Environment and Forestry, 2022).

Spatial planning challenges in Kisaran City also stem from plantation land dominance, disaster risks, and deviations from regional planning predictions. Addressing these issues requires prioritizing decentralization, creating growth centers, and improving infrastructure to support sustainable urban development(Abduletal.,2024).Similartootherregions,thetransitionfromagriculturaltonon-agricultural land introduces socio-economic challenges such as job displacement and reduced social interaction, underscoring the need for balanced growth through sustainable land management and alternative agricultural development (Eko Suharizki et al., 2024).

UrbanGOSnotonlyensuresecologicalbalancebutalsocontributestocommunitywelfare.Studies highlight the significant role of sustainable practices, such as oil palm cultivation, in rural development, despitechallenges likelabormanagementandenvironmental concerns.Thisunderscorestheimportance of governance structures and holistic approaches to land use management (Arga et al., 2024). These findings align with urban GOS planning, where the integration of ecological, social, and economic factors is critical.

Communityempowermentstrategies,suchas"onehouseonejumantik,"demonstratethepotential forlocalizedprogramstoimproveurbanenvironments.However,limitedresourcesandinfrastructureoften hinder the success of these initiatives, as seen in Pekanbaru City (ArgaAbdi Rafiud Darajat Lubis et al., 2024).Similarly,thesuccessofecotourisminitiatives,suchasthoseinSeiNagalawanVillage,showsthat creative economic solutions can strengthen community welfare and ensure long-term benefits, provided technological and governmental support are improved (Anisah, 2024).

Research emphasizes the importance of data-driven approaches to GOS planning. Tinambunan (2006) identified insufficient green space in Pekanbaru City, while Siregar (2016) stressed the need for analysisbasedonpopulationandoxygendemand.Moreover,integratingadvancedtoolssuchassatellite imageryandGeographicInformationSystems(GIS)canyieldaccurateevaluationsofGOSadequacyand distribution(Gulo,2008;Siska,2023).Thedevelopmentofsustainablefoodsystemsandagribusiness,as observed in Medan City and Lintong Nihuta, further demonstrates the intersection of land use, economic resilience, and regional growth (Muliadi et al., 2024; Lubis, S. N., 2023).

This study aims to analyze the GOS needs in Kisaran Timur Subdistrict comprehensively by evaluatingthebalancebetweenbuilt-uplandandGOS,projectingGOSrequirementsbasedonpopulation growth, and identifying optimal locations for GOS development. By addressing these challenges, this research contributes to sustainable spatial policies that align with ecological and socio-economic goals, reflecting broader efforts to enhance urban resilience and community welfare (Satia Negara Lubis &Arga Abdi Rafiud Darajat Lubis, 2024).

II. ResearchMethodology

ResearchType

This study employs a descriptive approach using qualitative methods. The objective is to analyze the demand and availability of Green Open Space (Ruang Terbuka Hijau, RTH) in the Kisaran Timur Subdistrict based on collected data. Qualitative methods allow for the extraction of descriptive narratives from various sources to gain a comprehensive understanding of the phenomenon (Bodgan & Taylor in Barowi & Suwandi, 2009).

StudyArea

The research was conducted in Kisaran Timur Subdistrict, Asahan Regency. This area was selected due to rapid residential development, which poses a potential threat to ecological balance by reducing green open spaces. Kisaran Timur is among the regions with the highest population growth in Asahan Regency.

DataTypesandSources

Thestudyutilizedsecondarydataobtainedfrom:

1. Relevantgovernmentagencies,suchastheEnvironmental AgencyandthePublicWorksand Spatial Planning Agency of Asahan Regency.
2. Official government websites, including the Central Bureau of Statistics (BPS) and other onlineplatforms.

Thecollecteddataincludes:

- Landcoverdata(shapefiles)for2013and2023.
- Populationdatafrom2000to2023.
- Administrativeboundaryandland-usedata.

DataCollectionMethods

Datacollectionwascarriedoutthroughtwomainmethods:

1. Requestsfordatafromrelevantgovernmentinstitutions:
    - Publicgreenspacelocationdatafromthe EnvironmentalAgency.
    - LandcovershapefilesfromthePublicWorksandSpatialPlanning Agencyof Asahan Regency.
2. Downloadingdatafromofficialsources:
    - PopulationdatafromtheBPSwebsite.

To verify the accuracy of the secondary data, ground checks were conducted, including capturing GPScoordinates, direct observations, and documenting the condition of existing green spaces.

DataAnalysis

Dataanalysiswasconductedusingacombinationof QGISandMicrosoftExcel,withthefollowingsteps:

LandCoverAnalysis

- **Mapcropping:**Thestudyareawasdelineatedbasedontheadministrativeboundariesof Kisaran Timur Subdistrict.
- **Groundverification:**Fieldobservationswereconductedtovalidatetheinterpretedmapdata.
- **Land cover classification:** Data were categorized into green open spaces, built-up areas, and other potential land uses using QGIS.

Analysis of RTH Needs Based on Area The ideal green open space requirement was calculated using the formula:

RTHRequirement(Ha)=Area(Ha)×20%

ThisanalysisestimatestheidealRTHareabasedonthesubdistrict'stotalarea.

AnalysisofRTHNeedsBasedonPopulationTherequiredRTHwascalculatedasfollows:

RTHpi=P*i*×K

Where:

- P*i*:Populationinarea*i*.
- K:RTHrequirementpercapita(aspertheMinistryofPublicWorksRegulationNo.05/PRT/M/2008).

Thiscalculationassessestheadequacyordeficitofgreenspacesbasedonpopulationstandards.

Green Space LocationAnalysis The optimal location for green spaces was determined using two variables:

1. **Landavailability:**Identificationofpotentialareasusinggrids,excludingunsuitablezones.
2. **Populationserved:**Calculationof thenumberof residentswithinthe service radiusbased on population density.

Theresultsfromtheseanalyseswerecombinedtogenerateanoptimalgreenspacelocationmap.

OperationalDefinitionsofVariables

1. **GeneralSpatialPlanofKisaranCity:**Aframeworkforoptimalandefficientspatialutilizationover a specified period.
2. **GreenOpenSpaceDevelopment:**ChangesintheextentanddistributionofRTHinKisaranTimur Subdistrict.
3. **RTHRequirements:**TheidealRTHareabasedonlandsizeandpopulationparameters.

Thisstructuredmethodologyensuresathoroughassessmentofthegreenspace needs andavailabilityin Kisaran Timur, contributing to sustainable urban planning efforts.

III. ResultsandDiscussion

GeneralOverviewofKisaranTimurSubdistrict

KisaranTimurSubdistrictispartofthecapitalofAsahanRegency,withatotalareaof3,892hectares(38.92 km²). This area is bordered by Rawang Panca Arga Subdistrict in the north, Air Joman Subdistrict in the east,SeiDadapSubdistrictinthesouth,andKisaranBaratSubdistrictinthewest.Thissubdistrictconsists of12villages,withthelargestvillagebeingKarangAnyer(5.97km²)andthesmallestbeingKisaranTimur (0.51 km²). The distribution of the area of each village is presented in Table 1.

Table1.AreaofVillagesinKisaranTimurSubdistrict

No.	UrbanVillage	Area(km^2)	Percentage(%)
1	Sentang	4,14	10,64
2	KedaiLedang	3,10	7,94
3	KisaranNaga	2,19	5,63
4	Teladan	0,70	1,80
5	KisaranTimur	0,51	1,31

6	Selawan	2,78	7,14
7	Mutiara	2,00	5,14
8	SiumbutBaru	2,70	6,94
9	Siumbut-umbut	2,90	7,45
10	KarangAnyer	5,97	15,34
11	GambirBaru	5,97	15,34
12	Lestari	5,96	15,31
Total		**38,92**	**100,00**

Source:*BPSKisaranTimurSubdistrict,2024*

AvailabilityofGreenOpenSpaceinKisaranTimurSubdistrict

The availability of public Green Open Space (GOS) in Kisaran Timur Subdistrict is still very minimal compared to the standard requirements. According to data from the Environmental Agency of Asahan Regency, GOS managed by the government is predominantly concentrated in Kisaran Barat Subdistrict, while Kisaran Timur Subdistrict only has several GOS locations, such as Taman Mantri Madjizat, Taman Sentang, and Stadion Mutiara. A detailed comparison of built-up land and GOS area between 2013 and 2023 is presented in Table 2.

Table2. ComparisonofBuilt-upLandandGOSAreasin2013and2023

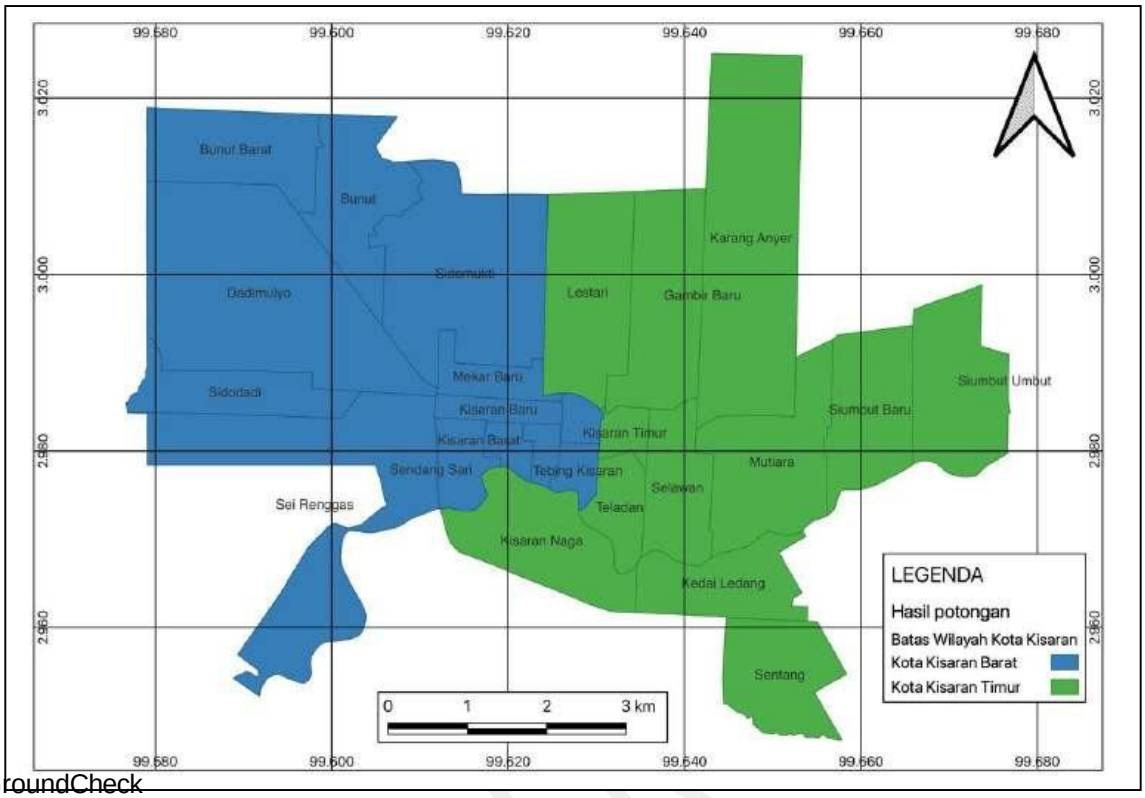
No	UrbanVillage	Build-upLandArea(Ha)			GOSArea(Ha)		
		2013	2023	difference	2013	2023	Difference
1	Sentang	15,34	21,10	5,76	-	0,90	0,90
2	KedaiLedang	10,44	28,72	18,28	12,16	12,31	0,15
3	KisaranNaga	21,80	44,56	22,76	19,22	19,37	0,15
4	Teladan	16,75	22,27	5,52	9,56	12,35	2,79
5	KisaranTimur	8,32	9,88	1,56	-	0,01	0,01
6	Selawan	23,08	31,11	8,03	10,62	11,71	1,09
7	Mutiara	15,61	36,56	20,95	8,18	8,57	0,38
8	SiumbutBaru	7,46	26,92	19,47	4,79	9,13	4,34
9	Siumbut-umbut	10,98	24,95	13,97	5,31	5,31	0,00
10	KarangAnyer	7,97	13,38	5,41	-	-	0,00
11	GambirBaru	12,05	21,10	9,04	-	0,07	0,07
12	Lestari	14,65	25,39	10,74	1,74	1,74	0,00
	TOTAL	**164,44**	**305,94**	**141,50**	**71,58**	**81,46**	**9,88**

LandCoverAnalysis

MapCropping

The analysis began with cropping maps using shapefile data from 2013 and 2023 for land cover and administrative boundary data from the Geospatial Information Agency (BIG). After the cropping and standardization process, the total area of Kisaran Timur City was determined to be 26,132,225.28 m².

Figure1.CroppedMapofKisaranTimur City



GroundCheck

Ground checks were conducted to verify map analysis results with field conditions. Documentation of severalGOSareassuchasTamanMantriMadjizat,TamanSentang,andStadionMutiaraisincludedinthe following images.

Figure2. GreenOpenSpace:TamanMantriMadjizatinKisaranTimurVillage

Figure3.GreenOpenSpaceTamanSentanginKisaranNagaVillage

Figure4.GreenOpenSpace:StadionMutiarainSelawanVillage

LandCoverClassification

Based on land cover classification, in 2013, KisaranTimur Subdistrict had 71.58 hectares of GOS, which increased to 81.46 hectares in 2023. However, this growth in GOS was not proportionalto the increase in built-up land, which reached 141.50 hectares. Detailed information can be seen in Tables 3 and 4, and Figures 5 and 6.

Table3.GOSDistributioninKisaranTimurSubdistrict(2013)

No	Village	Built-up LandArea (Ha)	GOSAreabyType(m^2)				Total GOSArea (Ha)
			Park	Public Cemetery	RiverBody	Riverbank	
1	Sentang	15,34					-
2	KedaiLedang	10,44		4.788,50	78.925,10	37.842,53	12,16
3	KisaranNaga	21,80	620,57		130.360,31	61.252,30	19,22
4	Teladan	16,75		35.468,69	37.560,60	22.544,12	9,56
5	KisaranTimur	8,32					-
6	Selawan	23,08	26.922,13	39.436,33	23.250,46	16.585,64	10,62
7	Mutiara	15,61			54.457,19	27.378,00	8,18
8	SiumbutBaru	7,46			25.638,99	22.286,96	4,79

9	Siumbut-umbut	10,98			30.817,18	22.263,15	5,31
10	KarangAnyer	7,97					-
11	GambirBaru	12,05					-
12	Lestari	14,65	14.481,48	2.917,38			1,74
	TOTAL	164,44	42.024,18	82.610,90	381.009,82	210.152,70	71,58

Figure5. LandCoverMapofKisaranTimurSubdistrict(2013)

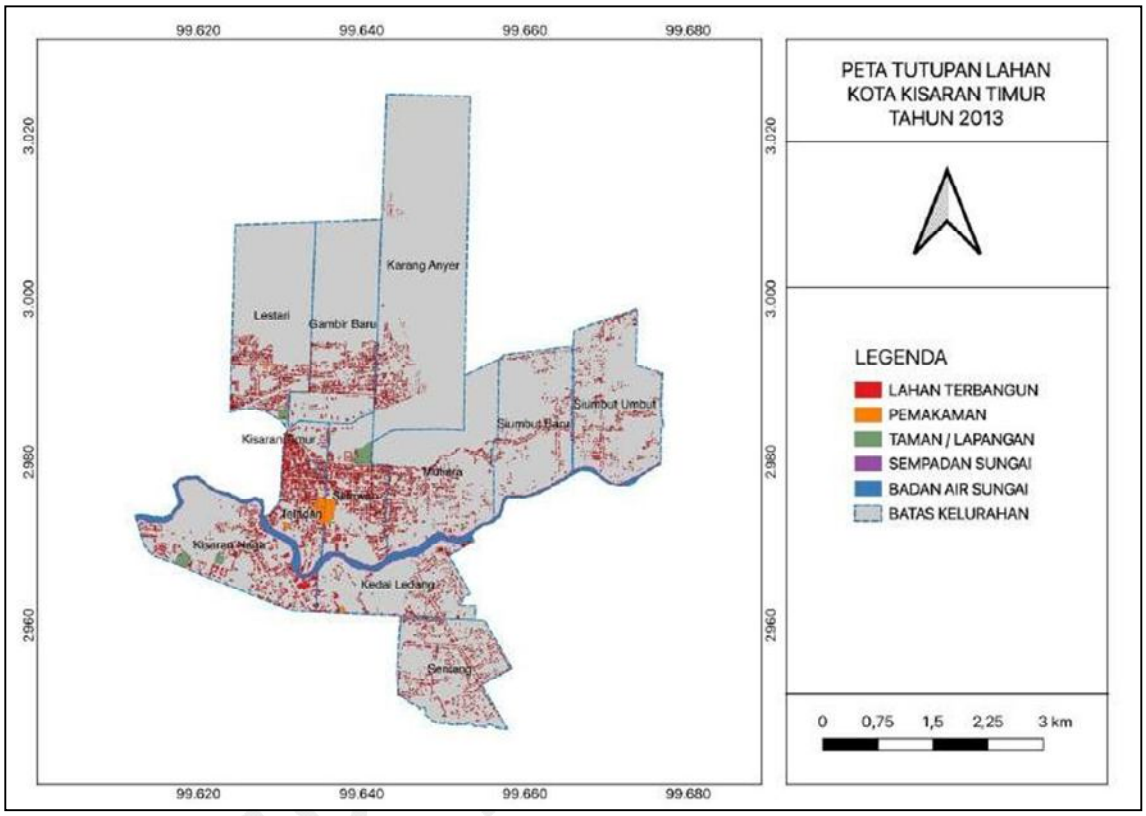
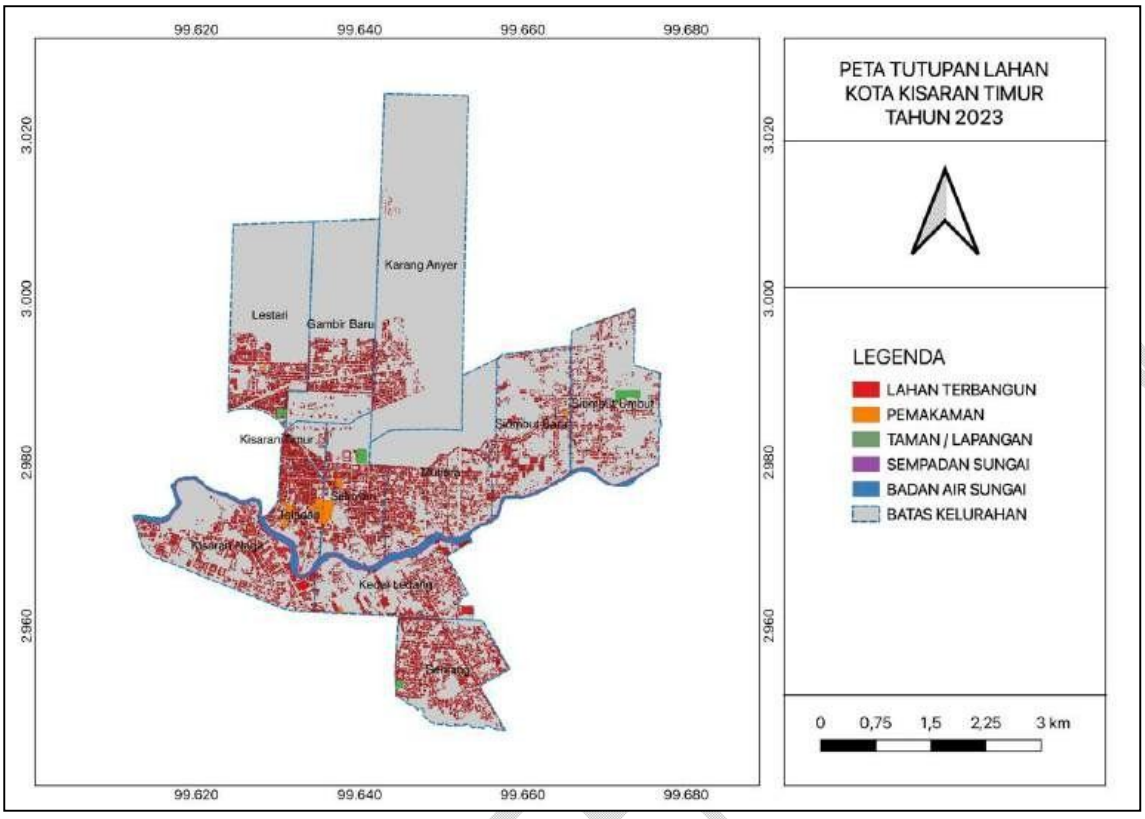


Table4.GOSDistributioninKisaranTimurSubdistrict(2023)

No	Village	Built-up LandArea (Ha)	GOSAreabyType(m^2)				Total GOS Area (Ha)
			Park	Public Cemetery	River Body	Riverbank	
1	Sentang	21,10	8.986,92				0,90
2	KedaiLedang	28,72		6.301,32	78.925,10	37.842,53	12,31
3	KisaranNaga	44,56	620,57	1.490,28	130.360,31	61.252,30	19,37
4	Teladan	22,27		63.394,48	37.560,60	22.544,12	12,35
5	KisaranTimur	9,88	83,91				0,01
6	Selawan	31,11	26.922,13	50.347,32	23.250,46	16.585,64	11,71
7	Mutiara	36,56		3.826,64	54.457,19	27.378,00	8,57
8	SiumbutBaru	26,92	38.874,33	4.508,16	25.638,99	22.286,96	9,13
9	Siumbut-umbut	24,95			30.817,18	22.263,15	5,31
10	Karang Anyer	13,38					-
11	GambirBaru	21,10	660,86				0,07
12	Lestari	25,39	14.481,48	2.917,38			1,74
	TOTAL	305,94	90.630,20	132.785,58	381.009,82	210.152,70	81,46

Figure6. LandCoverMapofKisaranTimurSubdistrict(2023)



AnalysisofPublicGOSNeedsBasedonArea

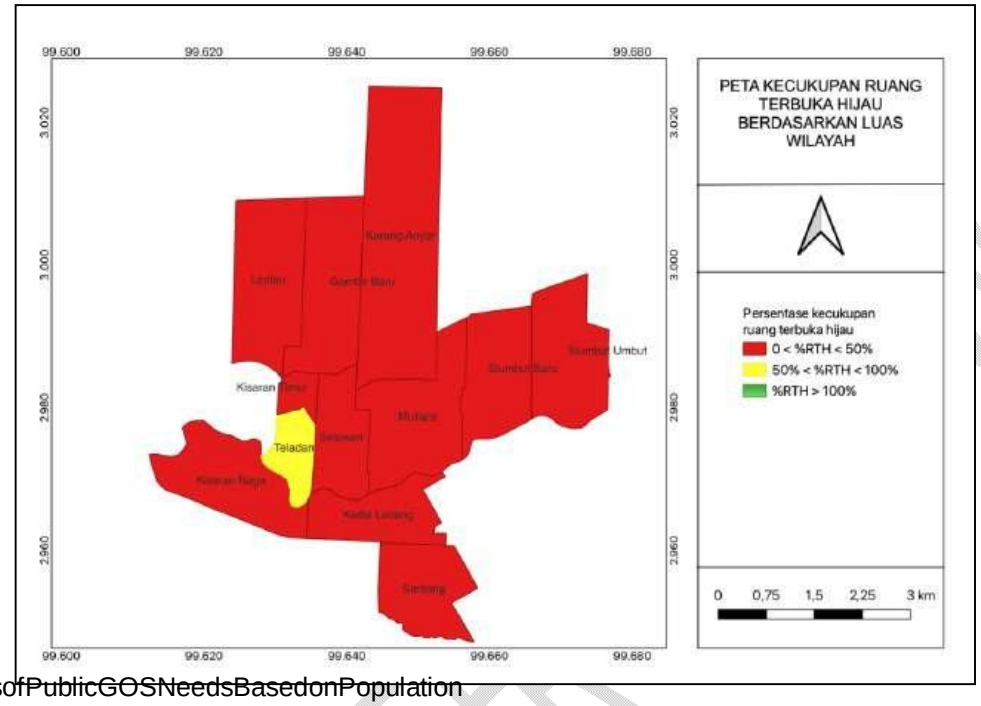
According to regulations, the minimum public Green Open Space (GOS) requirement is 20% of the total area.ForKisaranTimurSubdistrict,this translates to **522.64hectares**.However,currentGOSfulfills only **15.59%**ofthisrequirement,leavingasignificantdeficit.Detailedresultsarepresentedin**Table5**,whilethe analysis is visualized in **Figure 7**.

Table5.PublicGOSNeedsBasedonAreainKisaranTimurSubdistrict

No	UrbanVillage	Area (Ha)	Required GOS Area (Ha)	Current GOS Area (Ha)	Deficit (Ha)	Current GOS (%)	Notes
1	Sentang	181,26	36,25	0,90	-35,35	2,48	insufficient
2	KedaiLedang	166,28	33,26	12,31	-20,95	37,01	insufficient
3	KisaranNaga	233,37	46,67	19,37	-27,30	41,50	insufficient
4	Teladan	80,37	16,07	12,35	-3,72	76,83	insufficient
5	KisaranTimur	37,05	7,41	0,01	-7,40	0,11	insufficient
6	Selawan	148,18	29,64	11,71	-17,93	39,51	insufficient
7	Mutiara	267,49	53,50	8,57	-44,93	16,01	insufficient
8	SiumbutBaru	202,79	40,56	9,13	-31,43	22,51	insufficient
9	Siumbut-umbut	233,46	46,69	5,31	-41,38	11,37	insufficient
10	KarangAnyer	539,33	107,87	0,00	-107,87	0,00	insufficient
11	GambirBaru	253,52	50,70	0,07	-50,64	0,13	insufficient
12	Lestari	270,10	54,02	1,74	-52,28	3,22	insufficient

	2613,22	522,64	81,46	-441,19	15,59

Figure7.ResultsofPublicGOSNeedsAnalysisBasedonArea



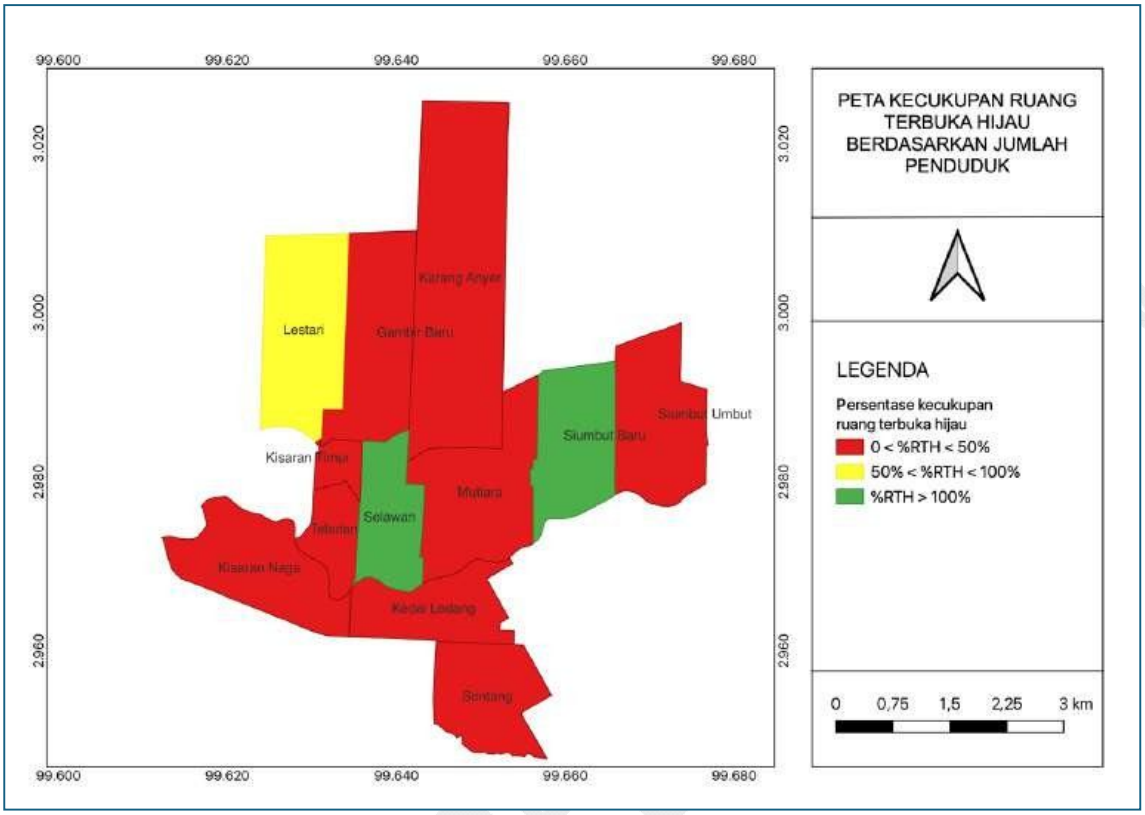
AnalysisofPublicGOSNeedsBasedonPopulation

The analysis of GOS needs based on population projections for 2043 reveals a significant deficit. With an estimatedpopulationof**122,421**,therequiredGOSforpublicspacesis**244,842m²**,basedonthestandard of**0.2 m² perperson for subdistrictparks**. Currently,onlytwo villages—**Selawan**and **Siumbut Baru**—meetthisrequirement.Detailedresultsarepresentedin **Table6**,whiletheanalysisisvisualizedin**Figure 8**.

Table6.AnalysisofMinimalPublicGOSNeedsBasedonPopulation

No	UrbanVillage	Required GOS (m^2)	CurrentGOS (m^2)	Deficit (m^2)	Current GOS (%)	Notes
1	Sentang	28.616	8.986,92	-19.629,08	31,41	Insufficient
2	KedaiLedang	15.774	0,00	-15.774,00	0,00	Insufficient
3	KisaranNaga	17.752	620,57	-17.131,43	3,50	Insufficient
4	Teladan	13.094	0,00	-13.094,00	0,00	Insufficient
5	KisaranTimur	6.056	83,91	-5.972,09	1,39	Insufficient
6	Selawan	21.186	26.922,13	5.736,13	127,08	Sufficient
7	Mutiara	39.834	0,00	-39.834,00	0,00	Insufficient
8	SiumbutBaru	29.864	38.874,33	9.010,33	130,17	Sufficient
9	Siumbut-umbut	31.352	0,00	-31.352,00	0,00	Insufficient
10	KarangAnyer	10.880	0,00	-10.880,00	0,00	Insufficient
11	GambirBaru	13.562	660,86	-12.901,14	4,87	Insufficient
12	Lestari	16.872	14.481,48	-2.390,52	85,83	Insufficient
		244.842	90.630,20	-154.211,80		Insufficient

Figure8. ResultsofMinimalPublicGOSNeedsAnalysisBasedonPopulation



AnalysisofPotentialLocationsforGOSDevelopment

The analysis of potential GOS locations used a **125 x 125-meter grid** based on a **2,500-meter service radius**.Aftertheeliminationprocess,**105grids**wereidentifiedaspotentiallocationsforGOSdevelopment.
Among the identified areas, **Mutiara Village** emerged as the most suitable, with the highest potential population served within the service radius. The results are visualized in **Figures 9-10**.

Figure9.MapofPotentialGOSLocationsinKisaranTimurSubdistrict

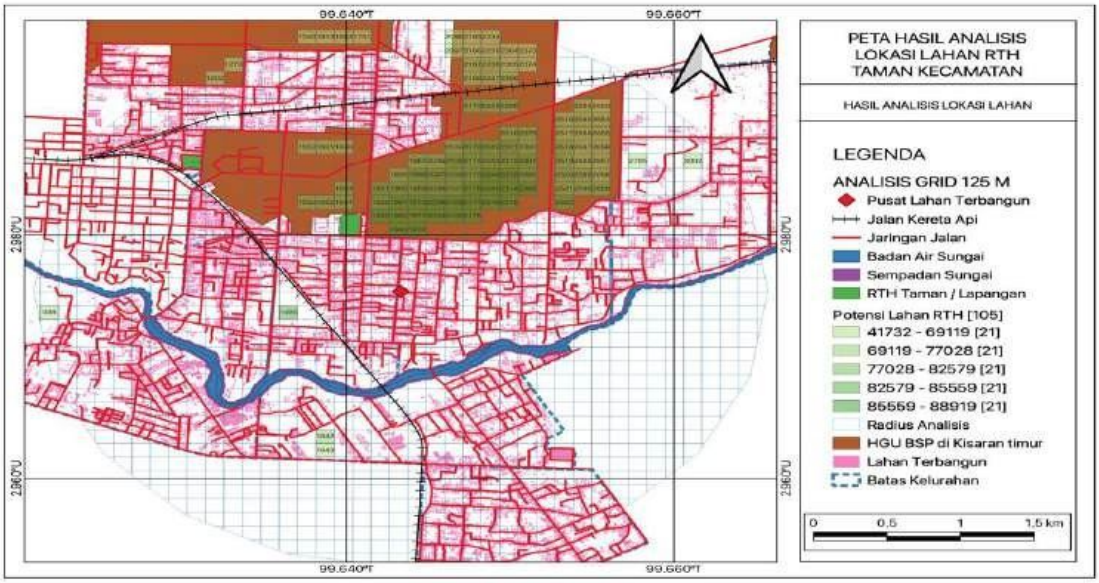
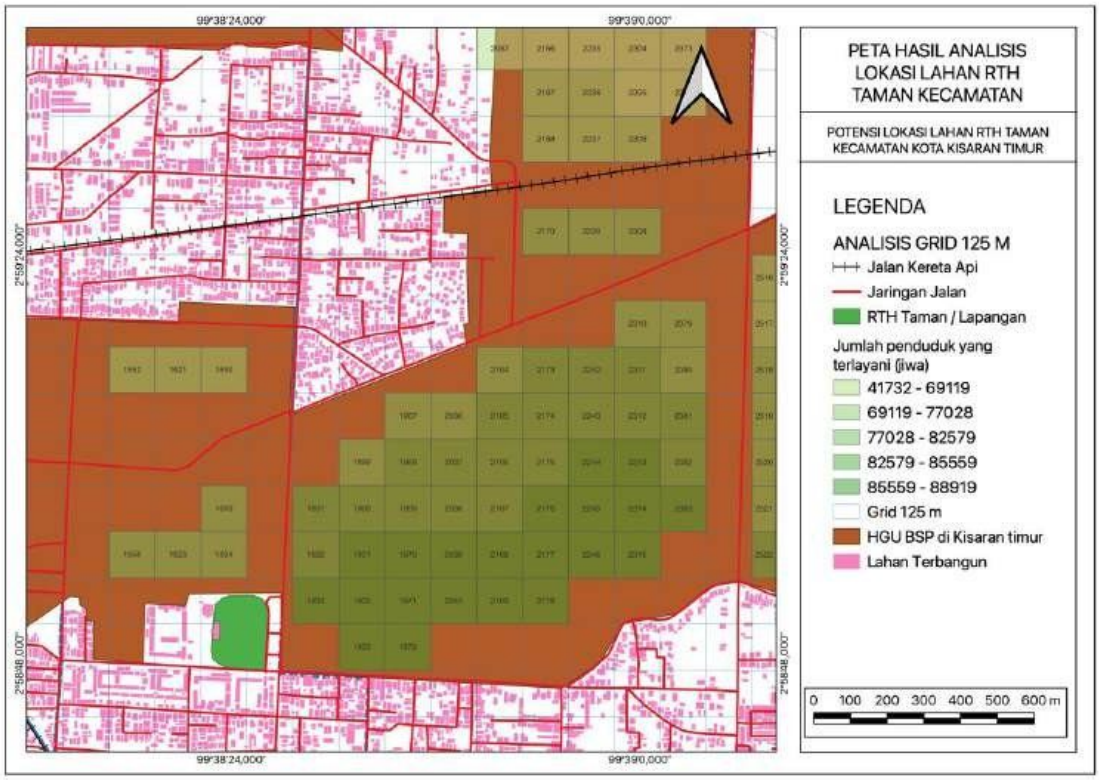


Figure10.OptimalLocationsforGOSDevelopmentinKisaranTimurSubdistrict



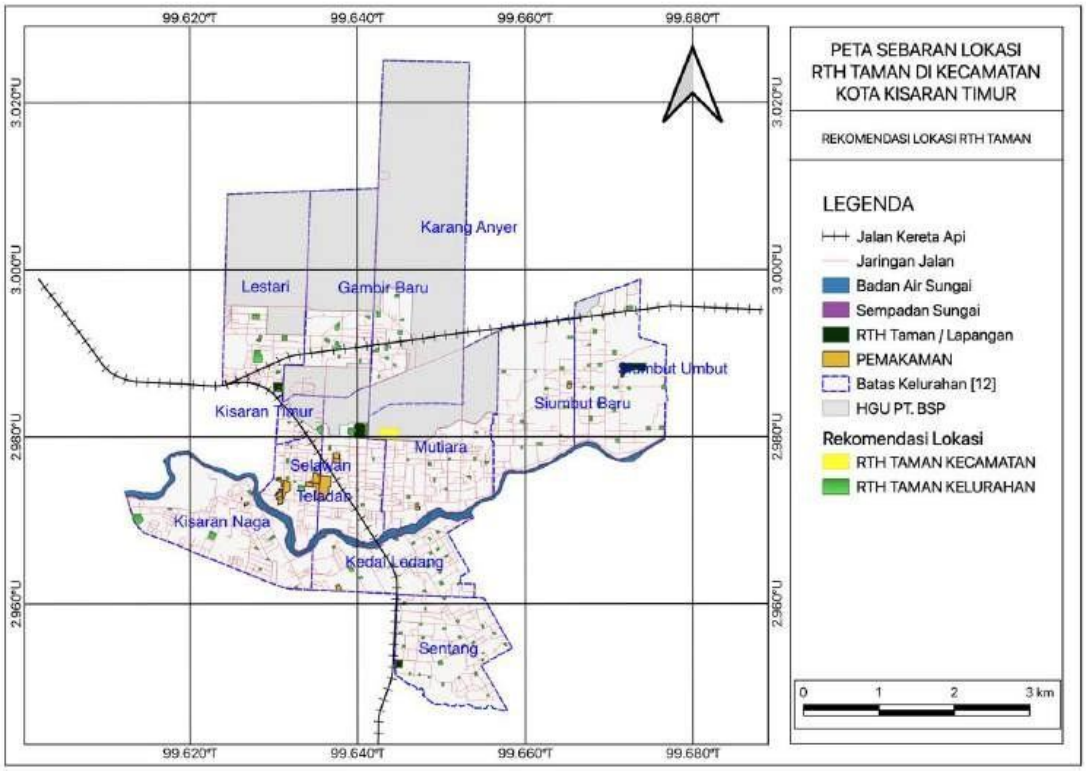
RecommendationsforVillage-LevelGOSPlanning

Based on theanalysis,the totalrecommendedGOS area is **354,599.98m²**,spreadacross **135locations** in Kisaran Timur Subdistrict. This additional GOS would enable all villages to meet the minimum GOS requirements. A breakdown of the proposed GOS expansions is detailed in **Table 7**, and the spatial distribution is shown in **Figure 11.**

Table7.ProposedGOSforVillagestoMeetRequirements.

NO	UrbanVillage	GOSArea (m^2)			Required GOS(m^2)	Notes
		ExistingGOS	Planned GOS	TOTALGOS		
1	Sentang	8.986,92	26.850,74	35.837,66	28.616	Sufficient
2	KedaiLedang	0,00	20.325,52	20.325,52	15.774	Sufficient
3	KisaranNaga	620,57	28.718,19	29.338,76	17.752	Sufficient
4	Teladan	0,00	13.343,29	13.343,29	13.094	Sufficient
5	KisaranTimur	83,91	6.860,66	6.944,57	6.056	Sufficient
6	Selawan	26.922,13	15.876,87	42.799,00	21.186	Sufficient
7	Mutiara	0,00	43.644,80	43.644,80	39.834	Sufficient
8	SiumbutBaru	38.874,33	14.981,68	53.856,01	29.864	Sufficient
9	Siumbut-umbut	0,00	34.191,58	34.191,58	31.352	Sufficient
10	KarangAnyer	0,00	17.433,04	17.433,04	10.880	Sufficient
11	GambirBaru	660,86	14.918,83	15.579,69	13.562	Sufficient
12	Lestari	14.481,48	26.824,58	41.306,06	16.872	Sufficient
	JUMLAH	90.630,20	263.969,78	354.599,98	244.842	Sufficient

Figure11. RecommendedGOSLocationsinKisaranTimurSubdistrict



4.8Discussion

Kisaran Timur Subdistrict experienced an increase in Green Open Space (GOS) from **71.58 hectares in 2013** to **81.46 hectares in 2023**. However, this 9.88-hectare increase over a decade is considered insufficienttomeettheidealrequirementof20%ofthetotalarea.Thishighlightsasignificantgapbetween the current conditions and the GOS standards outlined in regulatory provisions.

The GOS deficit in Kisaran Timur Subdistrict is further evidenced by population growth and its impact on public space needs. With the population projected to reach **88,919 by 2043**, the required public GOS for parksisestimatedat**244,842m²**.Basedonthestandardsoutlinedin**RegulationoftheMinistryofPublic Works No. 05/PRT/M/2008**, each individual requires at least **0.3 m² for village parks** and **0.2 m² for subdistrict parks**. This underscores the need for accelerated GOS development to balance population growth and address socio-ecological needs.

The concentration of GOS in Kisaran Barat Subdistrict poses a challenge for Kisaran Timur. Most GOS facilities,suchas**HutanKota**and**Alun-AlunKota**,arelocatedinKisaranBarat,whileKisaranTimurhas onlyafewsmall-scaleGOS,suchas**TamanSentang**and**StadionMutiara**.Thisimbalanceindistribution creates inequities in public access to green spaces and environmental quality.

Fromanecologicalperspective,thelackofadequateGOSinKisaranTimurSubdistricthasthepotentialto negatively impact local environmental quality. The limited green areas reduce water absorption capacity, increase flood risks, and exacerbate air pollution. Additionally, sufficient green spaces are critical for mitigating urban heat islands, improving air quality, and supporting urban environmental sustainability.

Spatial analysis identified **Mutiara Village** as the most promising area for GOS development.The village has sufficient vacant land and a high potential population to serve. Using spatial analysis with GIS, approximately**135potentiallocations**forGOSdevelopmentwereidentifiedinKisaranTimurSubdistrict, reflecting significant opportunities to meet future green space needs.

The designation of new GOS locations requires a strategic approach that integrates land availability and population needs. This study recommends the development of subdistrict parks with a **minimum area of 15,000 m²** as a priority solution. These parks can function not only as water absorption areas but also as venues for social and recreational activities. With a service radius of **2,500 meters**, these parks are expected to reach a larger population in the surrounding areas.

EffectiveGOSplanningmustalsoconsidersustainabilityaspects.Beyondmeetingecologicalneeds,GOS canprovidesocialandeconomicbenefits,suchasenhancingurbanaesthetics,reducingcommunitystress, andsupportinglocaleconomicactivitiesthroughtourism.Thus,GOSisnotonlyacriticalelementofurban spatial planning but also an integral part of sustainable urban development.

The development of GOS in Kisaran Timur Subdistrict requires collaboration among the government, community, and private sectors. The government must ensure supportive regulations for land acquisition forGOS,whilethecommunityandprivatesectorscancontributetogreeningeffortsandmaintaininggreen areas. These efforts demand a long-term commitment to creating a healthier and more comfortable living environment for residents.

The importance of spatial planning policies oriented toward ecological and social needs cannot be overstated. WithrapidpopulationgrowthandextensivelandconversionprovidingsufficientGOS inKisaran Timur Subdistrict is an urgent priority. The sustainability of the region depends not only on physical infrastructure development but also on balancing human needs with environmental preservation.

Throughappropriateplanningmeasures, KisaranTimurSubdistrict hassignificantpotentialtoenhanceits environmentalqualitythroughadequateGOSdevelopment.Thisstudyprovidesanempiricalfoundationfor local governments to develop more targeted policies toward realizing environmentally friendly and sustainable urban development.

IV. ConclusionandRecommendations

KisaranTimurSubdistrictfacessignificantchallengesinprovidingGreenOpenSpace(GOS)inaccordance with national standards. In 2023, the total GOS in the subdistrict was recorded at **81.46 hectares**, an increase from **71.58 hectares** in 2013. However, this growth is disproportionate to the expansion of built- up areas, which reached **141.50 hectares** over the same period. Based on the needs analysis, the subdistrict requires at least **522.64 hectares** of public GOS, equivalent to **20% of the total area**, as mandated by **Law No. 26 of 2007**. This shortfall means that most villages, including those with high population densities, fail to meet the ideal public GOS requirements.

Additionally, with the projected population in 2043 expected to reach **122,421 residents**, the calculated public GOS requirement is **244,842 m²**. However, only two villages—**Selawan** and **Siumbut Baru**—currently meet these needs. The uneven distribution of GOS exacerbates the limited public access to the ecological, social, and aesthetic benefits of green spaces.

Thisstudyalsoidentified**MutiaraVillage**astheoptimallocationforsubdistrictparkdevelopment,offering the largest land potential and the highest number of residents that can be served. Overall, the findings emphasizethecriticalneedformoretargetedplanningandmanagementofGOStoachieveecologicaland social balance in urban areas.

References

Abdul Hamid Akhyar Samosir, Satia Negara Lubis, & Arga Abdi Rafiud Darajat Lubis. (2024). Policy strategiesforspatialplanninginregionaldevelopmentofKisaranCity,AsahanRegency,Indonesia: English. *Asian Multidisciplinary Research Journal of Economy and Learning, 1*(1), 27–34.

AnisahSari.(2024).Sustainablecommunityempowermentapproachesinthemangroveecotourismsector throughcreativeinitiativesinSeiNagalawanVillage,SerdangBedagaiRegency,Indonesia:English. *Asian Multidisciplinary Research Journal of Economy and Learning, 1*(2), 1–11. https://doi.org/10.70471/f8wchm54

ArgaAbdi Rafiud Darajat Lubis, Vaqqi RiehandaAgung, & Satia Negara Lubis. (2024). Evaluation of the self-helphousingassistanceprogram(BRS)inenhancingruralareaplanninginSubulussalamUtara Village, Simpang Kiri District, Subulussalam City, Aceh Province: English. *Asian Multidisciplinary Research Journal of Economy and Learning, 1*(1), 14–19.

Arga Abdi Rafiud Darajat Lubis & Henry Marpaung. (2024). Assessing the impact of sustainable independent oil palm cultivation on rural development: A case study of Angkola Sangkunur Sub-District, South Tapanuli Regency. *Asian Multidisciplinary Research Journal of Economy and Learning, 1*(2), 12–19. https://doi.org/10.70471/wrr95s87

Chung, S. (1988).Aconceptual model for regional environmental planning centered on carrying capacity measures. *Korean Journal of Regional Science, 4*(2), 117–128.

Eko Suharizki, Zulkifli Nasution, Agus Purwoko, & Arga Abdi Rafiud Darajat Lubis. (2024). Evaluation of housingdevelopmentgrowthinAsahanRegency:English.*AsianMultidisciplinaryResearchJournal of Economy and Learning, 1*(1), 7–13. https://argaelpublisher.com/index.php/amjel/article/view/2

Fandeli,C.(2004).*PerhutananKota*.FakultasKehutananUniversitasGadjahMada.

Kyushik, O. (2004). Determining development density using the urban carrying capacity assessment system. Department of Urban Planning, Hanyang University, Seoul National University, Korean Environment Institute.

Lubis, S. N., et al. (2024). [Conference presentation]. *IOP Conference Series: Earth and Environmental Science, 1356,* 012033. https://doi.org/10.1088/1755-1315/1356/1/012033

Lubis,S.N., &Lubis,A.A. R.D.(2024). EnhancingIndonesiancoffeetrade: Strategiesfornavigatingand reducing trade barriers. *International Journal of Innovative Research and Scientific Studies, 7*(3), 1248–1267. https://doi.org/10.53894/ijirss.v7i3.3231

Masrizal,SatiaNegaraLubis,&ArgaAbdiRafiudDarajatLubis.(2024).Evaluationoftheself-helphousing assistanceprogram(BRS)inenhancingruralareaplanninginSubulussalamUtaraVillage,Simpang KiriDistrict,SubulussalamCity,AcehProvince:English.*AsianMultidisciplinaryResearchJournalof Economy and Learning, 1*(1), 14–19.

Muliadi, M., Lubis, S. N., Harahap, H., Slamet, B., & Lubis,A.A. R. D. (2024). Sustainable food systems andregionaldevelopment:AnalyzingfoodsecurityinMedanCity'sunderprivilegedareas,Indonesia. *Journal of Ecohumanism, 3*(6), 529–537. https://doi.org/10.62754/joe.v3i6.4023

Oh, K. (1998). Visual threshold carrying capacity (VTCC) in urban landscape management:Acase study of Seoul, Korea. *Landscape and Urban Planning, 39*(4), 283–294.

Oh,K.,Jeong,Y.,Lee,D.,&Lee,W.(2002).Anintegratedframeworkfortheassessmentofurbancarrying capacity. *Journal of Korean Planning Association, 37*(5), 7–26.

Pham,D.U.,&Nobukazu,N.(2007).Applicationoflandsuitabilityanalysisandlandscapeecologytourban greenspace planning in Hanoi, Vietnam. Graduate School for International Development and Cooperation, Hiroshima University.

RizkiAlda, Zulkifli Nasution, Satia Negara Lubis, &ArgaAbdi Rafiud Darajat Lubis. (2024). The influence ofeducation,social,andhealthcareexpendituresonthehumandevelopmentindex(HDI)inBireuen Regency: English. *Asian Multidisciplinary Research Journal of Economy and Learning, 1*(2).

Simpson, J. R., & McPherson, E. G. (1999). Carbon dioxide reduction through urban forestry: Guidelines forprofessional and volunteer tree planters. *General TechnicalReport PSW-GTR-171.*Albany,CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture.

Tiurma Gulo, Satia Negara Lubis, & Arga Abdi Rafiud Darajat Lubis. (2024). Income analysis of coffee farmers and its impact on regional development (Case study: Pematang Sidamanik District, SimalungunRegency,Indonesia):English.*AsianMultidisciplinaryResearchJournalofEconomyand Learning, 1*(1), 20–26.

Tyrväinen, L. (1998). The economic value of urban forest amenities: An application of the contingent valuation method. *Landscape and Urban Planning, 43,* 105–118.

UrbanForestResearch.(2002).Managingstormwaterrunoffwithtrees.CenterforUrbanForestResearch, Pacific Southwest Research Station, USDA Forest Service.

Zhang, L., Liu, Q., Hall, N. W., & Fu, Z. (2007). An environmental accounting framework applied to green spaceecosystemplanningforsmalltownsinChinaasacasestudy.*EcologicalEconomics,60,*533– 542.

LegalRegulations

Undang-UndangNomor26Tahun2007tentangPenataanRuang.

Undang-UndangNomor6Tahun2023tentangPenetapanPeraturanPemerintahPenggantiUndang- Undang Nomor 2 Tahun 2022 Tentang Cipta Kerja Menjadi Undang-Undang.

PeraturanMenteriPekerjaanUmumNomor05/PRT/M/2008tentangPenyediaandanPemanfaatanRuang Terbuka Hijau di Kawasan Perkotaan.

PeraturanMenteriAgrariadanTataRuang/KepalaBadanPertanahanNasionalRepublikIndonesiaNomor 14 Tahun 2022 tentang Penyediaan dan Pemanfaatan Ruang Terbuka Hijau.