JGISE Vol. 7 No. 1 (2024), pp. 1 - 13 | https://doi.org/10.22146/jgise.84015

JGISE
Journal of Geospatial Information Science and Engineering
ISSN: 2623-1182 | https://jurnal.ugm.ac.id/jgise

Assessment Of Land Capability And Zoning For Sustainable Urban Development In Ambon City

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Diterima (*Received*): 22/04/2023 Direvisi (*Revised*): 06/01/2024 Diterima untuk Publikasi (*Accepted*): 16/05/2024

ABSTRACT

The optimization strategy replaces ability-useful land with conservation-source power land, which may help with problem degradation. Investigate this to determine the level of land ability and the function area designation for good protection and cultivation in the Satuan Wilayah Pengembangan (SWP). The research method is descriptive and quantitative, with stepwise data collection and processing. Data collection is carried out through studies and literature from several agencies. Temporary spatial data analysis was conducted using Geographic Information System (GIS) software. The research findings underscore a significant aspect regarding land analysis, specifically about allocating areas for settlement purposes. The documented 3687.35 hectares identified as suitable for settlement development, alongside the approximately 11755.27 hectares allocated as buffer zones, highlight a limited portion of land deemed suitable for urban expansion within the studied region. This observation underscores the challenge of finding suitable and adequate spaces for urban development initiatives in Ambon City. Identifying such a confined area underscores the need for strategic urban planning that considers land constraints, such as the predominantly hilly terrain, to ensure balanced development, efficient land use, and the preservation of environmental integrity. Efforts toward optimizing these available areas for urban growth while concurrently focusing on conservation and ecological sustainability become imperative for Ambon City's future urban development trajectory. They created a barrier to physical land where hilly areas dominate the characteristics of the Ambon City area.

Keywords: Optimization, Region, Land Capabilities

1. Introduction

The main focus of continuous discussion by researchers and policymakers is population growth, which continues to increase in urban areas (Li & Yao, 2009) due to a significant population increase. Namely, around 50% of the world's population is currently concentrated in urban areas (Ritchie & Roser, 2018), and it is expected to reach 70% in 2050 (UNICEF., 2017). The rapid growth rate of the world's urban population, especially in developing countries, is one of the main challenges for governments and planning agencies (Amri & Giyarsih, 2022; Syafitri and Santosa, 2020). Around 3.9 billion people, or 54 percent of the world's population, live in urban areas and are expected to reach 6.3 billion by 2050 (United Nations, 2018). Cities will host nearly 90% of the growing urban population in the future, especially in cities in developing countries (Das & Angadi, 2022).

This trend has become a rapid spatial manifestation and will continue in the future (Li & Yao, 2009). The result is the spatial expansion of cities beyond their juridical boundaries into their interior and peripheral areas (Mosammam et al., 2017). Along with the rapid increase in urban population, urban space continues to develop (Hammad et al., 2019). The driving factor for this population increase is due to urban-rural population migration (Přívara et al., 2020), cross-regional mobility (Paul, 2020), and two-way urban-urban flows (Xia et al., 2019).

Urban land use has caused environmental consequences in developing sustainable urban space and spatial modes of urban land change (Dong et al., 2019). It has become an essential topic in urban land research. As a result, effective governance and planning to achieve a more sustainable form of cities is critical for urban planners and policymakers (Klein et al., 2017). In other words, metropolitan areas and spatial expansion are needed to minimize the wasteful use of non-renewable resources, avoid disturbing ecosystem balances, reduce social inequality, and promote sustainable and inclusive development (Gries & Schneider, 1995; Mosammam et al., 2017).

For four decades, cities in Indonesia have experienced dramatic population growth (Prihatin, 2015). This population growth is closely related to land-use changes (Leyk et al., 2020). This has caused the value of ecosystem services to decline rapidly, driven by urbanization over the past few decades (W. Liu et al., 2019; Devi and Santosa, 2022). This condition impacts the availability of space in urban areas, which is fixed and limited, resulting in space being taken up in suburban areas (Schibuola & Tambani, 2020). This space requirement impacts environmental conditions on built-up land (Zarlin et al., 2022).

The region's rapid development has increased physical, economic, and sociocultural development activities (Surya et al., 2018). Land needs are increasing, especially for urban activities (Cobbinah & Niminga-Beka, 2017; Aristalindra et al., 2020). The increasing need for built-up land and its limited availability require special attention to providing it (Bjørn et al., 2016). Therefore, it needs to be aligned based on land capability (Ilham et al., 2021). Land use that is not in harmony with the allocation of land capabilities will accelerate the decline in land productivity (Tscharntke et al., 2012; Zarlin et al., 2022).

On the other hand, increasing urban demand necessitates efficient land use planning due to limited capacity and availability of land (Kombe & Kreibich, 2000). These considerations include water resources, soil and rock characteristics, slope, and disaster vulnerability, which reflect land capability (Kumar et al., 2021). Because each land has limited powers and differs between areas (Guisan & Thuiller, 2005), it is necessary to prevent the "race to the bottom" and manage urban resources, particularly the amount of scarce land, to achieve sustainable and inclusive urban physical development.

One of the main concerns that must be considered to build a diverse and sustainable metropolitan city is the management of land resources (Dong et al., 2019). Land market mechanisms that divide available land resources for use by various parties sometimes need to function more effectively and economically (T. Liu et al., 2016). The expansion of informal settlements and housing backlog problems are critical national challenges that must be addressed (Barry et al., 2007). Inappropriate urban land use activities can cause land degradation through erosion. One way to overcome this problem is to manage land appropriately based on land capability (Khaledian et al., 2017).

Land capability reflects soil conditions, topography, climate, hydrology, and the dynamics that take place, especially erosion, flooding, and others (Duwila et al., 2019). A physical analysis of the rocks, slopes, geological vulnerability, groundwater potential, drainage, and rainfall is the most crucial way to determine the land's capability (Agnar et al., 2020).

Land use plans are optimized based on valuable land capabilities for soil resource conservation (De Feudis et al., 2021; Ndofah and Santosa, 2023). Land capability classification methods help reduce land degradation problems (Araújo Costa et al., 2019). Environmental management is carried out to sustain human life and other living things (Syaprillah, 2009). Starting from this, the RTRW policy for the Ambon City area has experienced significant development, so it is essential to regulate the growth of space allocation. This study aimed to assess land capability and determine the function of protected and cultivated areas in the Development Area Unit (SWP) in Ambon City.

2. Materials and Method

a. Location and Time Study

Ambon City, the province's center, is geographically located between 3 and 4 LS and 128 and 129 0 E (BPIW.PU, 2020). It is in the middle of the Maluku Province area, which is included in the Island Cluster Ambon and Lease Islands (KP3P, 2022). The area is also flanked by the Banda Sea, a depth of 7,000 meters, and the Seram Sea, which has a depth of 5,000 meters) (Bappeda Kota Ambon, 2008; Lasaiba, 2012). It is spread across the Inner and Outer Ambon Bays, extends inland around Ambon Bay, and is flanked by two peninsulas, namely the Jazirah Leihitu and Leitimur (BPS Kota Ambon, 2022).

Based on the projected results of the 2020 Population Census, it is known that in 2021, Ambon City will have more than 347 thousand residents, with an average annual growth of 0.46 percent and an average of every square kilometer in Ambon City being inhabited by around 967 people (BPS Kota Ambon, 2022). The area of Ambon City is about 359.45 km2, with a coastline of 98 km (Survey Tata Guna Tanah, 1980; Pemkot Ambon, 2022). The territorial boundaries are divided into 4 and 46 sub-districts (BPIW.PU, 2020). For area identification, delineation is carried out according to administrative area boundaries (Figure 1) by the Detailed Spatial Plan and District/City Zoning Regulations (JDIH BPK RI, 2011). The time needed to carry out this research is from January 2022 to August 2022.

b. Material and Tool,

This study's materials include primary and secondary data with the following details: Primary data consists of Landsat TM satellite images for 2021 obtained from the United States Geology Survey (USGS, 2021). Consider the impact of the sun's tilt, seasons, and clouds on image acquisition. Secondary data were obtained from the City Bapedda through Development Zone Unit maps, soil type maps, and field observations to assess accuracy. This study uses the ArcGIS 10.0 application to perform data analysis.

c. Method Analysis

a). Image Analysis and Classification

Atmospheric correction is necessary to extract quantitative information from Landsat accurately (Liang et al., 2001; Santosa, 2016). Landsat 8 OLI imagery is rescaled for image pre-processing to reflectance and Top of Atmosphere radians (TOA) using standard Landsat equations and scaling factors (USGS, 2021). A composite image is created based on the different bands of the Landsat image. The maximum likelihood classifier (MLC) was used for the spectral classification of satellite images based on training locations (signatures) at 30 m resolution and a projection system (UTM-WGS 1984).

In addition, the analysis uses a normalized spectral mixture (Wu, 2004) to overcome the problem of mixed pixels (Lu & Weng, 2005). After image classification, filter mode (5/5) is used for each classification to generalize supervised classified land-use images and remove isolated pixels (Lillesand et al., 2015). Also, the images are generalized and reclassified to make the final version of the existing land use map, which shows built-up land, plantations, forests, mixed gardens, and shrubs.

b). Analysis of Land capability

The classification of land capability using the inhibiting factor method involves an intricate process of assessing various factors influencing land suitability for specific purposes (Haris et al., 2021; Sari & Santosa, 2022). The threat difficulty, type of land, or property is evaluated using the approach from the best to the worst or the smallest to the largest (Antara & Aswitari, 2016) and then a table of criteria for each class: a minor impediment for the best class, and the more significant the impediment, the lower the class. Eight soil types are distinguished by Roman letters, numbered I through VIII (Figure 1) (Asmirawati, 2016).

Table 1. Types of soil differentiated by Roman numerals I through VIII

Number	Soil Type	Description
I	Mineral Soil	Rich in minerals and ores,
II	Clay Soil	Contains clay
III	Sandy Soil	High sand content
IV	Sandy Loam Soil	A mixture of sand and gravel
V	Silt Soil	Rich in silt
VI	Peat Soil	High organic material content
VII	Podzolic Soil	Iron-rich weathering process
VIII	Laterite Soil	High aluminum and iron content

c). Analysis of Designation of Area Functions

The Analysis of Land Use Allocation is crucial in determining the appropriate protection for the land's capability within a specific region, aligning with its current conditions (Laiko, 2010). Protected areas play a pivotal role as a balancing element within the environment, both locally and on a larger scale (Suganda et al., 2011). Seating protection and cultivation zones heavily rely on developing detailed spatial planning and zoning regulations at the district/city level, resulting in identifying areas suitable for cultivation. For those requiring safeguarding as protected zones (JDIH BPK RI, 2011), guidelines, as outlined in Table 2 below, are instrumental in determining appropriate and sustainable land use, considering both ecological needs and human activities in land management.

Table 2. Criteria for Designating Protected and Cultivation Areas based on Development Area Unit

Area Functions	Total Value Score
Protected area	> 175
Buffer Area	125 – 174
Area for Perennial Crop Cultivation, Area for Seasonal Crop Cultivation and Residential Area	< 125

Source: (SK Menteri N0 37, 1981)

3. Result and Discussion

a. Image Analysis and Assessment of Classification Accuracy

Radiometric correction is performed to eliminate or minimize atmospheric disturbances during the image recording. Usually, this disturbance can be in the form of absorption, scattering, or reflection, which causes the pixel values in the recorded image to not match the pixel values of objects in the field. The calibration principle changes the digital number (DN) value to reflectance.

The radiometric correction process in this study was carried out by subtracting all digital numbers in the band with numbers that are at a minimum statistical value. After the algorithm correction is applied to Landsat 8 imagery, the radiometric correction values ensure that the minimum value for each band is normalized to 0, while the maximum value is set to 1. Thus, the resulting scores for each band after the radiometric correction are indicated in Table 3.

Geometric correction is performed to rectify geometric distortions, obtaining an image with the same projection system and coordinates. Geometric correction requires Ground Control Points (GCPs) on the surface. The accuracy of GCP placement and the precision of the geometric correction can be determined by the Root Mean Square (RMS) value. The point is considered accurate when the RMS value approaches zero (Purwadhi, 2011). However, if the value is $\geqslant 1$ pixel, the point must be corrected again. Once each point has an RMS value $\leqslant 1$ pixel, the image is considered to be corrected. The geometric correction result with 15 GCPs achieved an RMS Error value of 0.00000, indicating precise results.

Table 3. Radiometric Correction Results

Basic Stats	Min	Max	Means	stdev
Band 1	0.000000	1.000000	0.274334	0.305856
band 2	0.000000	1.000000	0.252552	0.291377
band 3	0.000000	1.000000	0.248579	0.292707
band 4	0.000000	1.000000	0.24719	0.296323
band 5	0.000000	1.000000	0.262665	0.289627
band 6	0.000000	1.000000	0.029425	0.030847

Source: Correction Results Radiometric

Error matrices are used to assess classification accuracy. Table 3-5 uses the maximum likelihood classifier as the classification method. Overall accuracy indicates the percentage of well-classified pixels. The accuracy of the classification method is 91.39%, with a Kappa coefficient of 95%. Anderson (1976) states that 85% is acceptable as the minimum accuracy value. Therefore, the accuracy assessment is reliable. Producer and user accuracy ranges from 50.16% to 100% (Table 3), and the results of the classification and spatial distribution of land use are in Table 4 and Figure 1.

Table 4. Image Classification Error Matrix (%)

Class	1	2	3	4	5	Line Totals	User Ac (%)
1	2239	385	37	8	636	3305	65.67
2	0	3624	13	0	417	4054	87.66
3	0	0	96	0	0	96	100
4	0	0	0	135	0	135	100
5	0	1204	492	2	27,814	29,512	74.08
Column Totals	2239	5213	638	145	28,867	37.102	
accuracy Producer (%)	100	65.78	55.68	93.08	82.17		
accuracies Whole 91.39**Overall Kappa** 95%							

Class Legend: (1) Built-up Area, (2) Plantation, (3) Forest, (4) Garden Mixture, (5) Shrub thicket

Table 5. Identification of *Supervised Classified*

No.	Use Land	Area (Ha)	%
1.	Built Area	5.923,844	18,40
2.	Forest	7.875,105	24,46
3.	Garden Mixture	10.832,291	33,65
4.	Plantation	6.132,103	19,05
5.	Bush thicket	1.428,821	4,44
Total area		32.068,753	100,00

Source: Results of Data Analysis, 2022.

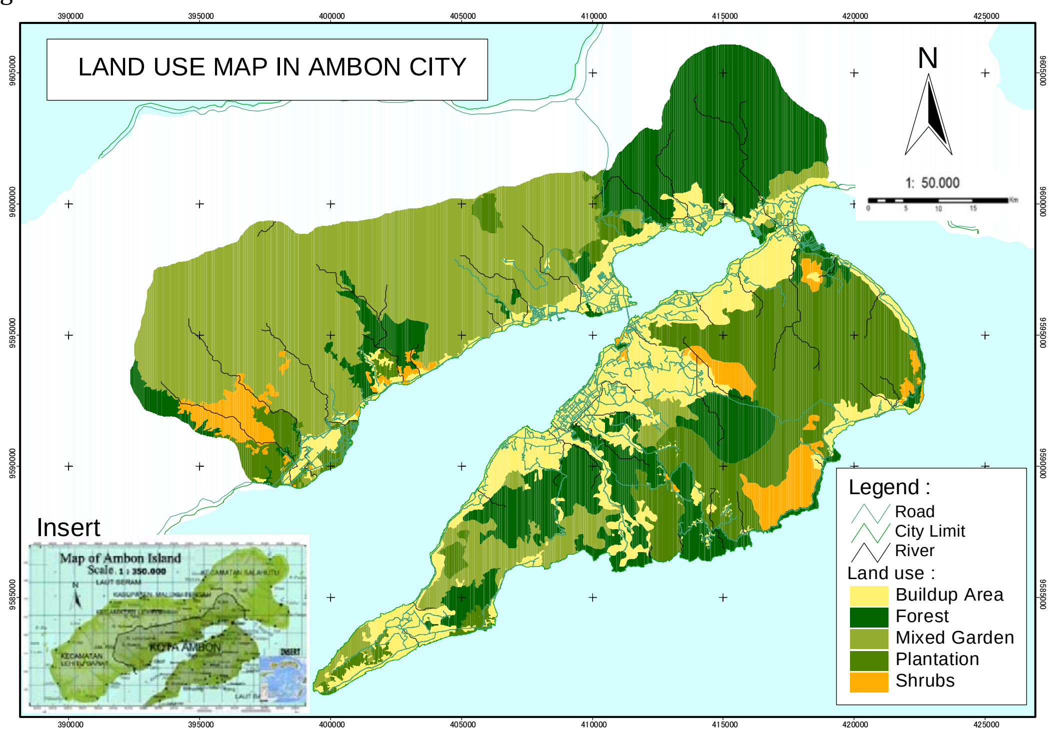

Figure 1. Land Use Map In Ambon City

b. Capability Analysis Land

The geo-biophysical data of the area that has been obtained is then converted into spatial data based on existing attribute data. The following process overlaps all the geo-biophysical parameters of the area used. The results obtained are presented by following the regional boundaries of Ambon City, which include 12 sub-districts. Based on the map overlay, it was found that land capability classes were mostly for particular areas, with class I having an area of 1,270,511 ha and SWP II having an area of 1,075,619 ha. Capability Class I land has few constraints that limit its use. Class I land is suitable for various services, and all cultivation activities can be carried out due to only a few limiting factors (Table 6).

As for land capability class II, most of it is spread over SWP II, with an area of 1,566,212 ha. Soils in capability class II land have several obstacles or threats of damage that reduce their choice of use or cause them to require reasonable conservation measures. So, the direction for utilization is more suitable in this class, namely as a cultivation area, but less intensive than in Class I. Overall, the land in the entire SWP has the potential for development or other activities such as cultivation. With existing Class II land, Will is expected to support land use activities for cultivation in the area. Land capability classes III to IV are directed to protected areas because they have obstacles or threats of damage that reduce their choice of use or result in the need for serious conservation measures. They are presented in Table 2 and spatially in Figure 2 for more details.

Table 6. Land Capability Class of Development Area Unit

No	Development Area Unit	Class	Area (Ha)	Percentage
1	2	3	4	5
1.	Special Region	I	1.270,511	3,97
		II	684,731	2,14
		III	2.771,586	8,66
		IV	1.929,888	6,03
		Sub-Total	**6.656,716**	**20,80**
2.	SWP I	I	561,178	1,75
		II	1.566,212	4,89
		III	604,810	1,89
		IV	447,120	1,40
		Sub-Total	**3.179,320**	**9,93**
3.	SWPII	I	1.075,619	3,36
		II	916,520	2,86
		III	171.360	5,35
		IV	1.921,363	6,00
		V	370,657	1,16
		Sub-Total	**5.997,767**	**18,73**
4.	SWP III	I	769,530	2,40
		II	190,717	0,60
		III	2.809,939	8,78
		IV	1.754,807	5,48
		V	176,904	0,55
		Sub-Total	**5.701,897**	**17,81**
5.	SWP IV	I	296,688	0,93
		II	296,358	0,93
		III	2.949,652	9,22
		IV	2.499,676	7,81
		V	379,008	0,12
		Sub-Total	**6.421,382**	**19,01**
6.	SWP V	I	481,004	1,50
		II	7.660,24	2,39
		III	1.19,562	3,81
		IV	1.786,600	5,58
		V	131,435	0,41
		Sub-Total	**4.384,625**	**13,69**
		Total	**32.068,753**	**100,00**

Source: Results of Data Analysis, 2022

Based on Table 6, the method for determining land capability classes in land capability classification is derived from overlaying inhibiting factors, which categorizes land into eight classes:

- Class I: Land with few inhibiting factors and minimal risk of damage. Suitable for various land uses, including agriculture, livestock, and settlements.

- Class II: Land with few inhibiting factors, suitable for diverse land uses but requires more intensive management to prevent damage.
- Class III: Land with moderate inhibiting factors, suitable for some land uses but needs intensified management to enhance productivity.
- Class IV: Land with severe inhibiting factors suitable for limited land uses such as grazing fields or production forests.
- Class V: Land unsuitable for agriculture but suitable for grazing fields, production forests, or nature reserves.
- Class VI: Land unsuitable for agriculture and grazing fields, suitable for protective forests or nature reserves.
- Class VII: Land unsuitable for agriculture, grazing fields, and production forests, suitable for nature reserves.

The research results indicate that land capability classes in the research area range from Class III to Class VI. Class III lands are scattered across several Satuan Wilayah Pengembangan (SWP). In contrast, Class VI lands have inhibiting factors such as fast soil permeability, high erodibility, and steep slopes, making them unsuitable for mixed farming or agriculture.

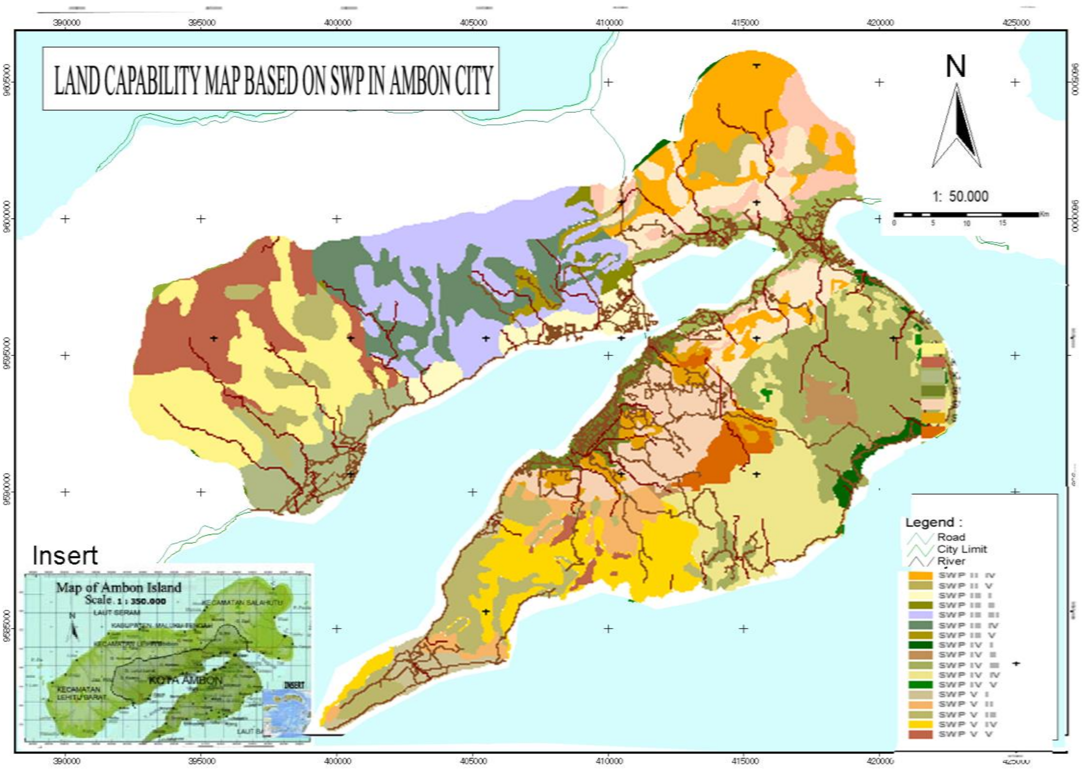

Figure 2. Land Capability Map Based On SWP I Ambon City

Moreover, in the special zones, as the first SWP, there is significant variation in land capability, with Class III dominating at 2,771,586 hectares (8.66%) and Class IV covering 1,929,888 hectares (6.03%). SWP I displays land development potential, with Class II being the largest at 1,566,212 hectares (4.89%). SWP II shows diverse land characteristics with dominance in Classes III and IV. SWP III exhibits Class III dominance at 2,809,939 hectares (8.78%). SWP IV demonstrates a more even distribution between Classes III and IV. SWP V shows Class IV as the largest, covering 1,786,600 hectares (5.58%). These results provide a solid foundation for land use planning in various SWPs, highlighting the potential and challenges associated with each land capability class. This data will assist authorities in decision-making regarding regional and sustainable development in Ambon City.

Land in Class I has few limiting factors, allowing various activities, while Class II lands, mainly in SWP II covering 1,566,212 ha, have some constraints or threats that reduce their options for use, requiring moderate conservation efforts. Thus, the most suitable utilization for this class is cultivation areas, but not as intensive as Class I. Overall, land in all SWPs potentially supports development or cultivation activities. However, Class II lands are expected to support land utilization activities for cultivation in those areas. Land capability classes III to IV are directed toward conservation areas due to inhibiting factors or threats that reduce their use options, requiring heavy conservation efforts. Class VI lands have inhibiting factors such as rapid soil permeability, high erodibility, and steep slopes, making them highly unsuitable for mixed farming or agriculture. The map of land capability spread across SWP is presented in Figure 2.

c. Function Analysis Region

The designation of a protected area in the Ambon City Area includes the criteria for a local protected area with a function as a riparian and flood-prone area. This area protects its nether regions in the form of protected forests and disaster-prone regions. In determining the function of the area, various factors must be considered, which include:

a) Factors Slopes

The description of the value of the slope class variable in determining cultivated and non-cultivated land to this process is obtained from the class level of the slope of the land itself. The classification regarding the slope class is presented in Table 7.

Table 7. Criteria for Land Slope Class

Slope Class	Slope Angle (%)	Description	Score
1	0-8%	Flat	20
2	8-15	Sloping	40
3	15-25	Rather Steep	60
4	25-40	Steep	80
5	> 40	Very Steep	100

Source: (SK Menteri N0 37, 1981)

Because slopes in the planning area are generally dominated by 15 to 25% and greater than 40%, development in the region has historically followed flat land relief with flat and not steep slopes (Table 8). Flat areas with a 0-8% slope are still dominated by built-up land. Each sub-SWP has a slope level between 15–30% and > 30 %.

Table 8. Slope Degree

No	Criteria		Area (Ha)	%
	Description	(%)		
1.	Flat to Sloping	0 – 8	5.087,65	15,80
2.	Slightly tilted	8 - 15	6.974,29	21,66
3.	Crooked	15-30	9.380,68	29,14
4.	Very slanted	> 30	10.750,05	33,39
Total area			32.068,753	100,00

Source: Results of Data Analysis, 2022

The Ambon Development Area Unit (SWP) is primarily hilly and mountainous, with steep slopes of around 33.39%. In comparison, the lowlands cover narrow areas with flat to slightly flat slopes (0–8%), covering a small area of 15.80%. Most of it has been developed for residential areas and other city support facilities. The topographical condition of an area or region can indicate slope stability, determine the direction of water discharge, and indicate areas prone to erosion and soil movement. Based on the above conditions, the slope class values in Ambon City can be found in Table 9, which is based on (SK Menteri N0 37, 1981), and in Figure 3, which is a map.

Table 9. Slope Class Score in Ambon City

No	Slope Class	Slope (%)	Description	Location	Score
1	III	15 – 30	Rather Steep	Entire Ambon City Area Or All Sub SWP	60
2	IV	> 30	Steep	Entire Ambon City Area Or All Sub SWP	80

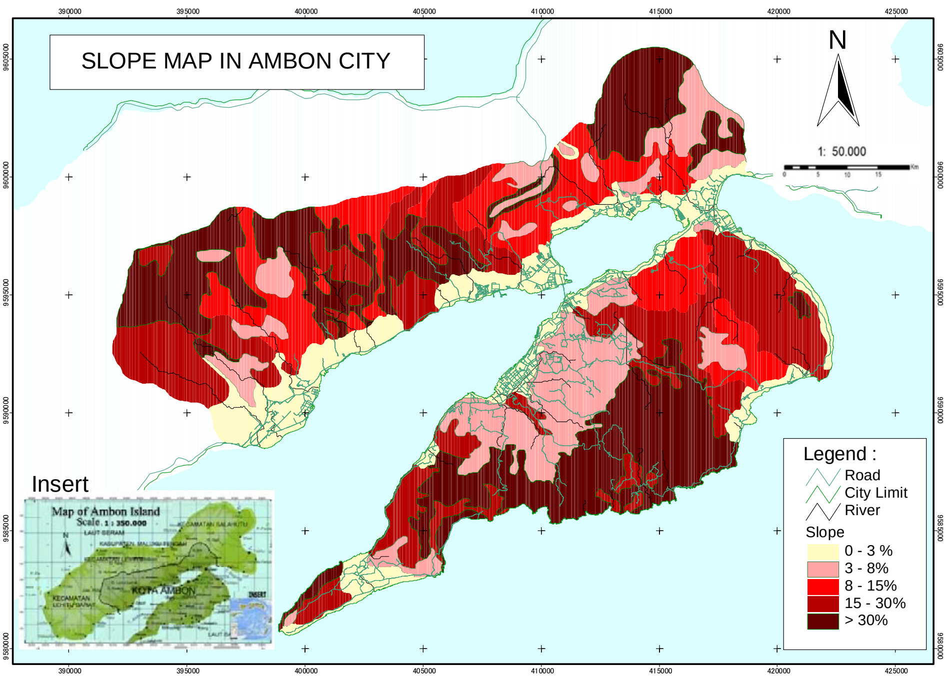

Figure 3. Slope Map In Ambon City

b) Soil Type

Soil type is determined by its sensitivity to erosion. The following is Table 10 regarding soil type classes in determining cultivated and non-cultivated areas. Based on the conditions above, it can be identified that the classification score for soil types in Ambon City reaches 75.

Table 10. Soil Type Class Criteria

No	Class	Type of soil	Description	Score
1	I	Alluvial, Soil Clay, Planosol, Hydromorph Gray, Groundwater Laterite	Not sensitive	15
2	II	Latosol	Less Sensitive	30
3	III	Brown Forest Soil, Non-Caltic Brown, Mediterranean.	Somewhat sensitive	45
4	IV	Andosol, Laterite, Grumosol, Podosol, Podzolic.	Sensitive	60
5	V	Regosol, Litosol, Organosol, Renzina.	Very Sensitive	75

Source: (SK Menteri N0 37, 1981)

Soil types based on the 1:50,000 Scale Soil Map show that in the study area, there are six types of soil units, which are groupings of the physical and chemical properties of the soil and the elements contained therein. The soil types in Ambon City are alluvial, brunizem, gleysol, cambisol, litosol, and renzina, and in general are dominated by cambisol, litosol, and regosol soil types. Moreover, it is still dominated by built-up land. The area of the land type unit in Ambon City can be seen in Table 10 below.

Table 11. Soil Type

No	Type of soil	Ha	%
1	Alluvial, Cambisol, Regosol, Gleisol	3.300,144	10,25
2	Cambisol, Litosol, Regosol	23.599,715	73,31
3	Litosol, Cambisol	1.969,064	6,12
4	Rensina, Cambisol, Litosol	3.323,746	10,32
Total area		**2,068,753**	**100,00**

Source: Results of Data Analysis, 2022

Table 11 shows that most of the Ambon City area has cambisol, litosol, and regosol soil type units with an area of 23,599.71 ha or 73.31%. At the same time, the smallest is spread over litosol and cambisol soil type units, which are 1,969,064 ha that indicating that almost the entirety of Ambon City exhibits soil characteristics ranging from brown to dark brown, with textures varying between sandy clay loam to silty loam and parent materials predominantly consisting of sandstone, granite, and peridotite-serpentine. The spatial distribution of these soil types depicts considerable variation across the region. Given these conditions, it is possible to identify the classification of slope class values in Ambon City according to Minister of Agriculture Regulation No. 837/KPTS/UM/11/1980 and No. 683/KPTS/UM/8/1982 as outlined in Table 12 and spatially represented in Figure 4.

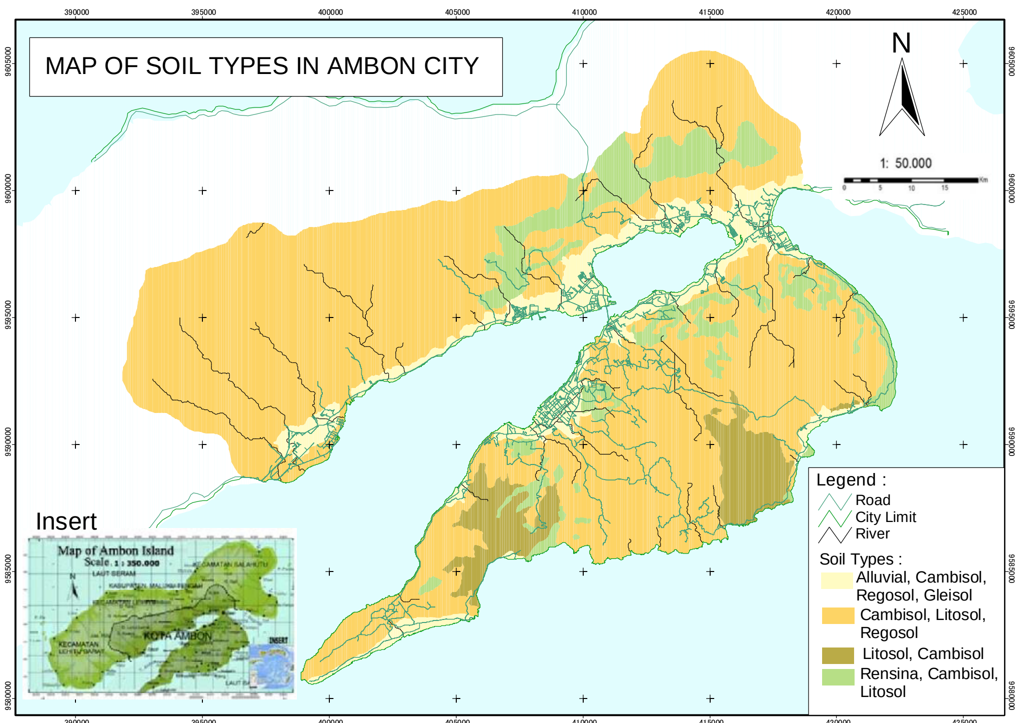

Figure 4. Map Of Soil Type In Ambon City

Table 12. Soil Type Score Value in Ambon City

No	Soil Class	Type of soil	Description	Location	Score
1	V	Cambisol, Litosol, Regosol	Rather Steep	Entire Ambon City Area Or All Sub SWP	75

Source: Results of Data Analysis, 2022

c) Rainfall Intensity Rain

Indonesia is a wet tropical climate region, so rainfall is the main factor in determining the climate (variety and fluctuation are very high). Due to the dominance of the rainfall factor, the characteristics and potential of agro-climatic resources are strongly influenced by rainfall. As with the previous scoring analysis, the score for how hard it rains will affect the land capability class. Table 13 shows how to figure out the score for how hard it rains.

Table 13. Rain Intensity Class Criteria

Rain Intensity Class	Rain Intensity	Description	Score
1	0 -13.6	Very low	10
2	13.6 - 20.7	Low	20
3	20.7 - 27.7	Currently	30
4	27.7 - 34.8	Tall	40
5	>34.8	Very high	50

Source: (SK Menteri N0 37, 1981)

Meteorology Pattimura Ambon had an adequate annual average rainfall over the last ten years (2013-2022) based on station data, which averaged around 26.162 m with total daytime rain of about 2309 days. Demonstrates that the rain intensity is high enough. Because the average year is 10.4 months wet and 1.5 months dry, the bulk precipitation that occurs in the area is intense enough even during a drought season. Based on the conditions above, the classification of rainfall intensity class values in Ambon City according to the Decrees of the Minister of Agriculture (SK Menteri N0 37, 1981) in Table 14 can be identified, which range from 27.7–34.8 m with a score for bulk rain intensity of 30 (moderate).

Table 14. Slope Class Score in Ambon City

No	Soil Class	Type of soil	Description	Location	Score
1	V	Cambisol, Litosol, Regosol	Rather Steep	Entire Ambon City Area Or All Sub SWP	75

Source: Results of Data Analysis, 2022

d. Results of Scoring Proficiency Land

A land function classification score, including protection, buffer, and cultivation functions, is calculated using slope, soil type, and average rainfall intensity. Table 14 shows that the final results show that in the SWP area, only two capabilities can buffer the area: cultivation and land. Based on the slope score, soil type, and rain intensity calculation in Ambon City, the land capability class for residential (built-up) areas is 3687.35 ha; of the total area, buffer zones are around 11755.27 ha, and protected areas are everywhere at 16750.05 ha. Thus, only a tiny part of the area that can be developed for processing is used on flat land in coastal areas. Climbing can be directed at a slope of 3 – 15% with a small land barrier to reduce the impact of land damage from various disasters that might occur. However, the development of buffer zones can also be applied as “green open space” or “green area development” as a form of ecological support and environmental services that offset settlement development activities in the SWP. The complete scoring results are presented in Table 15 below and spatially presented in Figure 4.

Table 15. Land Function Classification Score in Ambon City

No	Classification of Land Functions	Wide	Percentage
1.	Residential Area	3.687,35	11,45
2.	Buffer Area	11.755,27	36,52
3.	Protected area	16.750,05	52,03
	Total	32.068,753	100,00

Source: Results of Data Analysis, 2022

Criteria for Determining Protected and Cultivation Areas based on the Development Region (Table 16), the based on Minister of Agriculture Regulation No. 837/KPTS/UM/11/1980 and No. 683/KPTS/UM/8/198, where for Protected Areas (Score > 175), Buffer Zones (score 125 – 174), and Cultivation Areas and Settlement Areas (score <125). The land function classification values for diverse SWP in Ambon City represent a comprehensive assessment reflecting crucial land characteristics and suitability for various purposes. These values reflect crucial land function characteristics, including soil quality, slope inclination, and rainfall patterns. The Special Zone has the highest total score of 145, indicating its potential multifunctionality. Within SWP I, score variations reflect diverse roles, ranging from buffer zones to settlements and conservation areas, with a total score reaching 175. SWP II also displays diverse characteristics, emphasizing settlement and conservation functions. SWP III demonstrates the dominance of buffer and conservation functions, with a total score of 175. SWP IV presents a balanced distribution between settlement, buffer, and conservation functions. SWP V shows substantial variations, primarily focusing on buffer and conservation functions. This table provides valuable insights into land use potential and regional management, serving as a crucial foundation for sustainable development planning and land policies in Ambon City. This data creates a better understanding of the characteristics of each SWP, enabling more intelligent decision-making in developing and preserving these regions.

The land capability class for the settlement (developed) area reaches 3687.35 from the total area, the buffer area is about 11755.27 ha, and the conservation area is around 16750.05. This indicates that only a tiny portion of the area can be developed for settlements scattered in flatlands and partly in hilly areas. Since Ambon City is predominantly hilly, it is expected to ecologically support urban development activities in SWP. However, buffer area development can also be applied in the form of developing green open spaces or green areas as a form of ecological support and environmental services to balance settlement development activities in those SWP.

Table 16. Land Function Classification Score in Ambon City

No	Development Area Unit	Score			Score Value	Function Land
		Land	Slope	Rain		
1.	Special Region	35	80	30	145	Buffer Area
		25	40	30	105	Residential Area
		35	60	30	125	Buffer Area
		45	100	30	165	Protected area
2.	SWP I	15	80	30	125	Buffer Area
		15	40	30	85	Residential Area
		45	100	30	175	Protected area
		30	20	30	80	Residential Area
3.	SWPII	15	80	30	125	Buffer Area
		15	40	30	85	Residential Area
		15	60	30	105	Residential Area
		45	100	30	175	Protected area
4.	SWP III	15	80	30	125	Buffer Area
		15	40	30	85	Residential Area
		15	60	30	105	Residential Area
		45	100	30	175	Protected area
5.	SWP IV	35	80	30	145	Residential Area
		15	40	30	85	Residential Area
		30	60	30	120	Buffer Area
		35	100	30	165	Protected area
6.	SWP V	15	80	30	125	Buffer Area
		30	40	30	100	Residential Area
		45	100	30	175	Protected area
		75	20	30	125	Buffer Area

Source: Results of Data Analysis, 2022

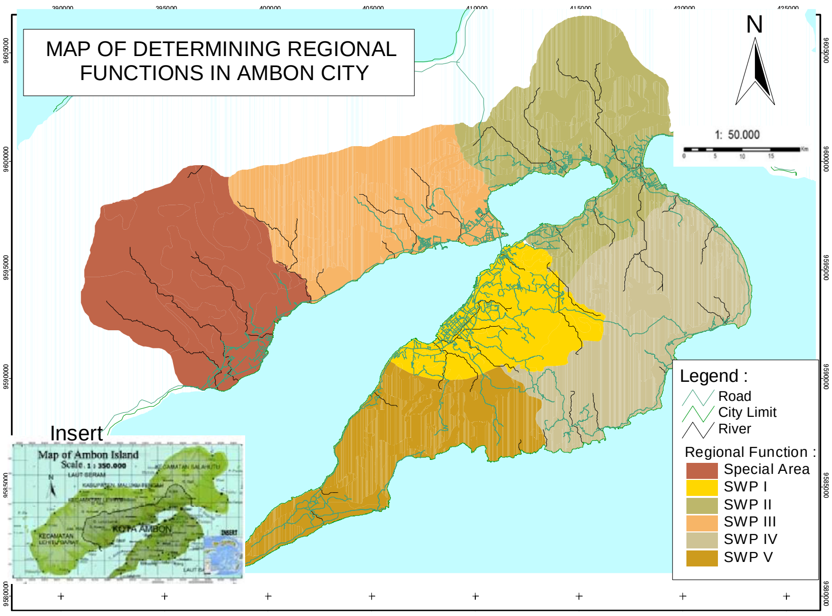

Figure 5. Map Of Determining Regional Functions In Ambon City

4. Conclusion

Based on the results of the land capability analysis, two capability classes, namely cultivation capability and land capability for buffers, and land capability classes I to IV, are obtained. Land capability classes I and II in the Ambon City Development Area Unit (SWP) have the potential to carry out development activities or cultivation activities. Analysis of Land Capability obtained land capability for settlements and buffers. Reached 3687.35 percent of the total area, buffer zones are around 11755.27 ha, and protected areas are around 16750.05 ha. It shows only a small area that can be developed for settlements scattered over the flat land and partly in hilly areas where it is known that the region's hills dominate the Ambon City area. They can support development activities in urban Ambon areas in an ecological way. Money can be directed at SWP. However, the development of buffer zones can also be applied to developing green open spaces or green areas.

5. Conflict of Interest

The authors declare no conflict of interest with any financial, personal, or other relationships with other people or organizations related to the material discussed in the article.

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