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EVALUATION OF LAND CAPACITY OF FOREST TREE TYPES IN THE KECAMATAN TUNTUNGAN KOTA MEDAN

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Abstract: This study was conducted in Medan Tuntungan District, Medan City, North Sumatra Province, which is a border area between Medan City and Deli Serdang Regency. This study aims to evaluate land capability for forestry plant types and multipurpose trees and provide recommendations for appropriate land use so that land productivity is maintained. The method used is quantitative descriptive with a survey approach and spatial analysis. The data used are secondary data obtained from related agencies, such as administrative maps, land use, slopes, and soil types. Similar studies have previously been conducted in several other areas but have not specifically examined the combination of forestry plant types in the Medan Tuntungan area. The evaluation results show nine land units with varying areas. Land capability class II is the largest, with an area of 1,171.371 hectares, while class IV is the smallest, with an area of 67.483 hectares. This study provides a new contribution to the management of specific land areas and becomes a reference in conservation-based land use planning.

Keywords: land capacity; forest tree types; land evaluation; kota medan

INTRODUCTION

Land has been one of the main elements in supporting the continuity of life since humans first inhabited the earth. Land functions as a place for humans to carry out activities to maintain existence (Nuraini, 2015). The first activity carried out was the use of land for farming. The functions of land control and use underwent a transformation in response to the expansion of human civilization and population. The physical capacity of the environment, as evidenced by topography, soil, hydrology, and climate conditions, as well as the dynamics that occur, particularly erosion and inundation, are all factors that contribute to land capability (Jainudin et al., 2021). Additionally, land capability, as defined by the Regulation of the Minister of State for the Environment No. 17 of 2009, refers to the features of land, such as soil quality, landscape, drainage, and other environmental factors that help support life or activities on that land (Wirawan, R. R., Kumurur, V. A., dan Warouw, 2019). Planning in using land must pay attention to environmental balance and sustainability. Currently, there is a tendency to utilize land for economic interests, which can increase income. When land use is determined by market selling prices, it leads to the planting of alternating types of crops (Rhenny Ratnawati, Moch. Shofwan, M. Nushron Ali Mukhtar & Nugroho, 2024).

The uneven distribution of the population has prevented proper utilization of most of the land. The majority of population density is located in areas with high soil fertility, resulting in population concentration. Land evaluation is an

important component in the land use planning process. Land capability classification is one form of land evaluation. (Munir et al., 2023) state that the results of this classification can be used to determine general land use directions, for example, for the cultivation of annual crops, plantations, production forests, and so on.

Land capability is an assessment of the land's capability for a particular use, assessed from each inhibiting factor (Irjadi et al., 2020). If land use doesn't align with its capabilities and doesn't incorporate effective soil conservation measures, it will hasten the erosion process. Erosive land leads to a decrease in land productivity (Afrianti et al., 2015). Land classification is intended so that the utilization of land is in accordance with its capabilities and how to apply soil and water conservation techniques that are in accordance with the capabilities of the land (Qamariyanti et al., 2023). The existence of forestry plants and multipurpose trees in Kecamatan Medan Tuntungan influences the suitability of plants in the district. Therefore, it is necessary to conduct research on the land capability of several forestry plants and multipurpose trees in Medan Tuntungan District so that the answer to the land capability in Medan Tuntungan District is found. The evaluation of land capability in this study was only carried out on the types of forestry plants and multipurpose trees located in Medan Tuntungan District.

This study is the first study to broadly assess the land skills of forest plants and multipurpose trees in the Medan area. In addition, the overlay-based spatial mapping approach provides different thematic maps for land unit identification compared to previous studies in the area. The findings of this study are expected to be considered by local governments in developing sustainable spatial planning policies and to base communities on the selection of systems that meet land skills to increase productivity in a sustainable manner and improve environmental efforts.

LITERATURE REVIEW

A. Land Evaluation

Land in a broader sense includes that which has been influenced by various human activities both in the past and the present (Christian et al., 2021). Activities such as the utilization of agricultural land, the reclamation of swamp and tidal land, or the implementation of soil conservation measures are examples. According to land, it is an area on earth that includes all the identifying signs, soil, atmosphere, geological features, hydrology, and animal and plant populations (Notohadiprawiro, 2021). In natural resource survey and mapping activities, one part of the land is distinguished from another based on differences in its characteristics, which consist of climate, landform (including lithology, topography, or relief), soil, and hydrology, so that land units are formed (Afrianti et al., 2015).

The land unit facilitates the identification of land capability classes. Land evaluation is the process of assessing or assessing the performance of land if used for a specific purpose, including the implementation and interpretation of surveys and studies of landforms, soil, vegetation, climate, and other land aspects, to identify and make comparisons of various alternative land uses that may be developed (FAO, 1976 in (Afrianti et al., 2015)). Land evaluation is a process of reviewing and interpreting basic data on soil, vegetation, climate, and other aspects of the land to identify and make initial comparisons between various alternative land uses, including simple socio-economic ones (Afrianti et al., 2015). From this opinion it can be concluded that land evaluation is a process of assessing land to identify it into land classes.

The table presents the structure of land capability classification, demonstrating its application across various planning scales. Land use planning in provincial areas can use classification at the class level and, for district areas, use subclasses.

B. Land Capability Class

Class I. Class I land has few obstacles that limit its use. Class I land is suitable for various agricultural uses, ranging from annual crops (and agricultural crops in general) to grass crops, forests, and nature reserves. Land in Class I has the following land characteristics and land quality: (1) located on almost flat topography, (2) little threat of erosion, (3) has a deep effective soil depth, (4) generally well-drained, (5) easy to cultivate, (6) good water-holding capacity, (7) fertile or responsive to fertilization, (8) not threatened by flooding, and (9) under a local climate that is generally suitable for plant growth (Budianta, 2024).

In dry climate areas where biogas facilities have been built, a land can be included in Class I if the topography is almost flat, the root zone is deep, the permeability and water-holding capacity are good, and it is easy to cultivate. Some of the land included in this class may require initial improvements such as leveling, sea salt washing, or seasonal lowering of the groundwater level. If there is obstruction by salt, the groundwater level is threatened by flooding, or the threat of erosion will occur again, then the land has permanent natural obstructions; therefore, it cannot be included in this class.

Class II. Lands in class 11 have few constraints or require moderate soil conservation measures. Class II land requires careful management, including soil conservation measures to prevent damage or improve air and water relations if the land is used for agriculture. Class II constraints are few, and the measures required are easy to implement. This land is suitable for use as annual crops, grasses, pastures, production forests, protected forests, and nature reserves (Ahada & Zuhri, 2020).

Class III. Class III land has severe constraints that reduce the choice of uses or require special soil conservation measures, or both. Class III land has more severe constraints than Class II land, and when used for crops that require soil management, the required soil conservation measures are usually more difficult to implement and maintain. Class III land can be used for annual crops and crops that require soil management, grasses, grasslands, production forests, protected forests, and wildlife sanctuaries.

Constraints in class III soil limit the duration of its use for annual crops, the time of cultivation, the choice of crops, or a combination of these constraints. Constraints or threats of damage may be caused by one or more of the following land relief characteristics: (1) steep or undulating slopes; (2) susceptible to eruption or having experienced severe erosion; (3) frequent flooding that damages crops; (4) subsoil with slow permeability; (5) shallow soil depth over rock, hardpan, fragipan, or claypan that limits rooting and water storage; (6) too wet or still saturated with water after drainage; (7) low water holding capacity; (8) moderate salinity or sodium content; or (9) relatively large climatic constraints. Class III soil typically displays a red color on land capacity maps.

Class IV. The constraints and threats of damage to class IV land are greater than class III, and the choice of plants is also more limited. If used for annual crops, more careful management is required, and soil conservation measures are more difficult to implement and maintain, such as bench terraces, vegetated channels, and control dams, in addition to measures taken to maintain soil fertility and physical conditions. Land in Class IV can be used for annual crops and agricultural crops in

general, grass plants, production forests, pastures, protected forests, or nature reserves (Utami et al., 2023). Problems or risks that can harm Class IV land come from one or more of these issues: (1) steep hills or slopes, (2) a high chance of erosion, (3) past heavy erosion, (4) shallow soil, (5) poor ability to hold water, (6) frequent flooding that can seriously damage plants, (7) too much water and the risk of ongoing flooding after drainage, (8) high salt or sodium levels, and (9) bad weather conditions. On land capability class maps, class IV land is usually colored blue.

Class V. Class V land is not threatened by erosion but has other obstacles that have not been removed and limit the choice of its use, so it is only suitable for grass, pasture, production forest, or protected forest and nature reserve. Land in class V has obstacles that limit the choice of types of use and plants and hinder the cultivation of land for annual crops. This land is located on flat or almost flat topography but is waterlogged, often flooded, rocky, has a less suitable climate, or has a combination of these obstacles.

Examples of class V land are (1) land that is often flooded, making it difficult to use for formal planting of annual crops. (2) flat land that is in a climate that does not support normal crop production. (3) flat or almost flat land that is rocky and (4) flooded land that is not suitable for drainage for annual crops but can be grown with grass or trees. On the land capability class map, class V land is usually colored dark green.

Class VI. Land in class VI has serious constraints that make this land unsuitable for agricultural use; limited use for grass or pasture; production forest, protected forest, or nature reserve. Land in class VI has limitations or threats of damage that cannot be eliminated in the form of one or a combination of the following factors: (1) located on a rather steep slope, (2) severe erosion hazard, (3) has been severely eroded, (4) contains soluble salts or sodium, (5) is rocky, (6) the root area is very shallow, or (7) the climate is unsuitable.

Class VII. Class VII land is not suitable for agricultural cultivation. If used as grassland or production forest, it must be done with heavy erosion prevention efforts. Class VII land with deep solum that is not sensitive to erosion must be made into bench terraces supported by vegetative methods for soil conservation if it is used for agricultural crops, in addition to fertilization measures.

Class VII land has several obstacles or threats of serious damage that cannot be eliminated, such as (1) being located on steep slopes, (2) having been eroded very heavily, even in the form of gully erosion, and (3) having a very shallow root area. On the land capability class map, class VII land is usually colored brown. Class VIII. Class VIII land is not suitable for agricultural cultivation, and it is better to leave it in its natural state. Class VIII land is useful as protected forests, recreation areas, or nature reserves. Limitations or threats of damage to Class VIII can be (1) located on very steep slopes, (2) rocky, or (3) very low water retention capacity.

Class VIII is dead land, exposed rocks, sandy beaches, and mountain peaks. On the land capability map, class VIII land is usually white or colorless (Osok et al., 2018). Criteria used in class grouping (Osok et al., 2018) are as follows:

1) Climate, the most important climate components that affect land capability are temperature and rainfall. Low temperatures affect plant types and growth. In tropical areas, the most important factor affecting air temperature is the height of a place above sea level. Freely moving air will generally decrease in temperature by 1°C for every 100 meters above sea level. Natural water supply in the form of limited or low rainfall in sub-humid,

semi-arid, and arid areas affects soil capability. Since the classification at each location is based on plant appearance, the interaction between climate and soil must be taken into account.

2) Slope, the slope of the slope is expressed in degrees or percent. Two points, 100 meters apart horizontally with a height difference of 10 meters, create a slope of 10 percent. The soil map records or identifies the steepness of the slope. The length and shape of the slope are not recorded on the soil map but can be an indicator of a particular soil type, and its effect on land use and management can be evaluated as part of the map unit.
3) Soil depth Effective soil depth is the depth of soil that is good for plant root growth, namely up to a layer that cannot be penetrated by plant roots. The layer can be a hard layer, clayey layer, brittle layer, or phlintite layer. Soil texture is an important factor that affects the capacity of the soil to retain water and soil permeability as well as various other soil properties and chemistry.
4) Permeability, permeability is the speed at which water seeps into the soil, either through macropores or micropores, both horizontally and vertically.
5) Special factors, these special factors include a) surface rock conditions, b) threat of flooding or inundation, and c) salinity (sea salt content).

C. Land Use

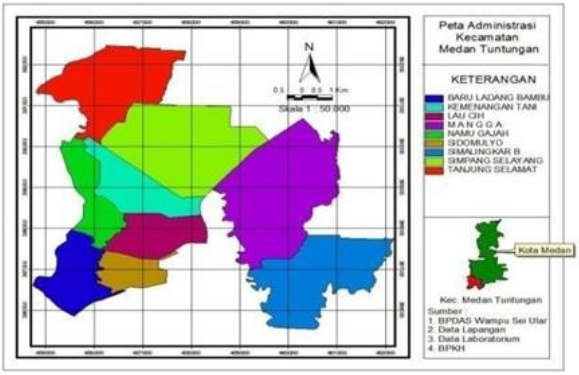
Land capability evaluation is a procedure that assesses the potential of land resources for diverse applications, influenced by characteristics such as terrain, climate, geology, geomorphology, soil, water, and vegetation (Lamanongko et al., 2021). The land under investigation exists in a complicated state and is neither a purely physical nor a socio-economic entity that operates independently. However, it is the outcome of interaction with its biophysical surroundings (Awaluddin & Belakang, 2022). The success of increasing agricultural production depends on land use planning that is in accordance with the land's capabilities. According to (Osok et al., 2018), land use is defined as any form of human intervention (interference) on land in order to fulfill their needs, both materially and spiritually.

Examples of land use types are as follows: 1) Cultivation, 2) Mixed annual crops, non-intensive dry land, 3) Mixed annual crops, intensive dry land, 4) Rice fields once a year, not intensive, 5) Rice fields twice a year, intensive 6) People's plantations (rubber, coffee, cocoa, or oranges), not intensive 7) Intensive people's plantations, 8) Large non-intensive plantations, 9) Large intensive plantations. 10) Natural production forests, 11) Production forests, pine plantations, and so on, 12) Non-intensive grazing fields, 13) Protected forests 14) Nature reserves.

RESEARCH METHODS

A. Research Location

Figure 1. Percentage of the area of the sub-district from the area of the district



Source: Author, 2025

The research location is Kecamatan Tuntungan, Kota Medan, Provinsi Sumatera Utara. Kecamatan Medan Tuntungan is one of the districts located on the border of

Medan City and Deli Serdang Regency. Kecamatan Medan Tuntungan is one of the districts in Medan City, covering an area of approximately 2,790.218 ha.

B. Data Collection

This research uses a quantitative descriptive method, namely a research method carried out with the main aim of creating a picture or description of a situation objectively that is related to the problem being researched (Dawis et al., 2023) with a survey approach and spatial analysis. The data used consists of secondary data. Secondary data is data obtained from collecting land resource information data available in several related agencies. Evaluation is carried out on each land unit resulting from the overlay between administrative maps, land use, slope, and soil type to assess the suitability and actual capability of the land for the use of forestry plants and multipurpose trees. The following are limiting factors in the classification of land capability according to (Ramadhani et al., 2023):

Table 1. The main constraints used in land capability classification

Limiting Factors	Presentation
Slope Gradient	Class I : 0–3% (very flat to flat) Class II : >3–8% (slope) Class III : >8–15% (slightly skewed) Class IV : >15–25% (oblique) Class V and beyond: >25% (steep – very steep)
Effective Soil Depth (sd)	In : >90 cm Currently : 50–90 cm Shallow : 20–50 cm Very Shallow : <20 cm

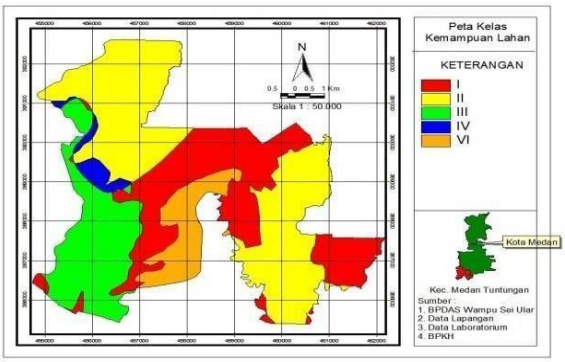
Source: (Klingebiel & Montgomery, 1961)

RESULTS AND DISCUSSION

A. Evaluation of Land Capability Class in Tuntungan District

The overlay of the administrative map of Medan Tuntungan District, along with the land use, slope, soil, and land cover maps, resulted in the identification of 9 land units with varying areas. The largest land unit is land unit III, covering an area of 619.378 hectares (22.198%), and the smallest is land unit IX, covering an area of 0.0174 hectares (0.006%). Land management must be in accordance with land capability so as not to reduce land productivity. Land capability is the basic nature of the land's ability to provide optimal and sustainable results for certain uses. Determination of the land capability class is based on factors used as variables, namely slope (g), soil texture (s), permeability (p), effective soil depth (sd), drainage (w), and soil erosion (e) land capability (Utami et al., 2023). It can be seen in Table 3, Table 4, Figure 2 and Figure 3.

Figure 2. Land Capability Class Based on Land Units



Source: Author, 2025

On the Medan Tuntungan land capability map above, the red area is a class

I land capability area, which is the most fertile land with good drainage, gentle slopes, and almost no physical constraints, making it ideal for almost all types of food crops, horticulture, and plantations. Plants can grow optimally here with high productivity and minimal management requirements. The yellow area is a class II land area, which is still relatively fertile but has few constraints, such as moderate drainage or the presence of small rocks. Food crops and horticulture can still grow well in this class, although simple management is required, such as additional fertilization or crop rotation.

The green area is classified as class III land, characterized by significant restrictions such as suboptimal soil texture, unstable drainage, or steep slopes. This restricts the selection of appropriate plants, including cassava, corn, or beans, and necessitates conservation management techniques, such as terracing. The blue area is a class IV land area; in this IV land condition, it is increasingly difficult because of the high risk of erosion, steep slopes, and the possibility of shallow or infertile soil. Only certain plants that are resistant to environmental stress conditions can grow here, such as sweet potatoes, elephant grass, or fast-growing trees such as sengon (Nugroho et al., 2022).

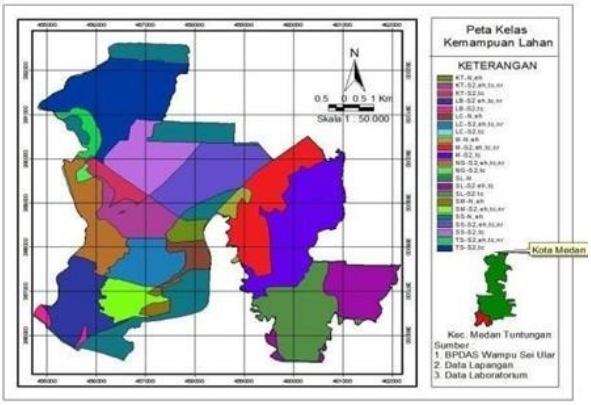
Table 3. Land capability class area based on sub-district

ward	Class	Wide	
		Ha	%
Simalingkar-B	I	154,413	5,534
	II	232.61	8,337
	VI	10,243	0.367
Ladang Bambu	I	14,357	0.515
	III	169,917	6,090
Sidomulyo	I	24,906	0.893
	III	57,409	2,058
	VI	21,298	0.763
Lau Cih	I	80,567	2,887
	II	10,546	0.378
	III	50,794	1,820
	VI	44,735	1,603
Mangga	I	224.5	8,046
	II	316,545	11.345
			5
	VI	24,006	0.860
Tanjung Selamat	I	53.39	1,913
	II	326.107	11.688
	III	90,216	3.233
	IV	30,232	1,083
Simpang Layang	I	217.59	7,798
	II	169,878	6,088
	VI	33,691	1.207
		2790.218	100

Source: Author, 2025

Soil conservation management is essential to prevent further degradation. The orange area is a class VI land area that is considered very limited for agriculture because the slope is very steep, the soil is very shallow, and the erosion rate is very high (Holik et al., 2024). This terrain is unsuitable for plant agriculture and is better suited for reforestation with species such as vetiver, bamboo, or hardwood trees like teak and mahogany, or for use as a conservation area.

Figure 3. Land Capability Class Based on Sub-district



Source: Author, 2025

Based on the results of the land capability evaluation, the research area is divided into nine land units, namely land capability classes I to VI. From Table 2, it can be seen that land capability class II is the largest area in Medan Tuntungan District, at 1171.371 ha, located in Simpang Selayang, Mangga, Tanjung Selamat, Lau Cih,

Kemenangan Tani, Namu Gajah, and Simalingkar-B Villages. While the smallest area in Medan Tuntungan District is land capability class IV of 67.483 ha, located in Sidomulyo, Kemenangan Tani, Lau Cih, Mangga, and Simalingkar-B Villages.

Table 2. Land resource information data

No	Ward	Wide	
		Ha	%
1	Tanjung Selamat (TS)	499,945	13.95
2	Simpang Selayang (SS)	421,159	23.80
3	Namu Gajah (NG)	168,492	6.97
4	Kemenangan Tani (KT)	263,776	6.97
5	Lau Cih (LC)	186,642	4.04
6	Sidomulyo (SM)	103,613	4.37
7	Ladang Bambu (LB)	184,274	6.27
8	Simalingkar -B	397,266	20.60
9	Mangga (M)	565,051	13.02
		2790.218	100

Source: Author, 2025

Land capability class I is found in land units I-III and in the sub-districts of Simalingkar-B, Ladang Bambu, Mangga, Kemenangan Tani, Namu Gajah, Simpang Selayang, Tanjung Selamat, Lau Cih, and Sidomulyo. There are factors that inhibit erosion in land unit I, factors that inhibit erosion in land unit II, and factors that inhibit drainage erosion in land unit III. Land capability class II is found in land units IV and land units V and in the sub-districts of Simpang Selayang, Mangga, Tanjung Selamat, Lau Cih, Kemenangan Tani, Namu Gajah, and Simalingkar-B. Slope is the inhibiting factor that land capability class II possesses.

This can be seen from the nature of class II soil, which is rather sensitive to erosion, so that steep slopes greatly affect agricultural efforts. Slope as an inhibiting factor in class II is often found in areas in Medan Tuntungan District so that agricultural efforts only run in certain areas. Class III land capability is found in land unit VI and in the sub-districts of Ladang Bambu, Namu Gajah, Sidomulyo, Kemenangan Tani, Lau Cih, Tanjung Selamat with slope inhibiting factors. Based on this, the ideal land use in this class is land for annual crops and plants that require soil cultivation with moderate conservation measures. To prevent mud and compaction, organic materials are generally needed, and plants should not be cultivated in wet conditions, and soil conservation is needed to prevent erosion on sloping land (Arsyad, 1989).

Land capability class IV is found in land unit VI and in Tanjung Selamat, Namu Gajah, Kemenangan Tani, Sidomulyo, and Lau Cih sub-districts with slope-inhibiting factors. This class can be utilized but requires conservation measures in the form of bench terraces, vegetated channels, and inhibiting dams (Arsyad, 2006). Ideal land use is in the form of annual crops, agricultural crops, grass plants, production forests, grazing fields, protected forests, and nature reserves. Without conservation measures, the land may sustain damage.

Land capability class VI is located in land unit VIII and land unit IX in Sidomulyo and in the neighborhoods of Kemenangan Tani, Lau Cih, Mangga, and Simalingkar-B, where land unit VIII has factors that prevent slopes and land unit IX has factors that prevent erosion. Based on the limiting factors of class VI, the use of this class of land is limited and not suitable for

agricultural use. Ideal use is grazing fields, production forests, protected forests, or nature reserves. The use of annual crops such as plantations can be an option in land capability class II. However, you can use it on land with deep roots and slightly sloping to slightly steep topography, provided you implement heavy conservation measures. Slope is an inhibiting factor for most land units in Kecamatan Medan Tuntungan. This is in accordance with the statement (Safir et al., 2024) that when viewed from the slope factor, most of them are class I to III because the land is in a flat to slightly sloping condition. The steeper the slope, the land capability class will approach class VIII, and conversely, the flatter the slope, the land capability class will approach class I. It states that slope is a permanent limiting factor.

CONCLUSION

This study was carried out in the Kecamatan Medan Tuntungan, Kota Medan to assess site suitability for forestry and multipurpose trees and to offer suitable land use suggestions. The applied methodology is quantitatively descriptive, employing a survey approach and spatial analysis based on secondary data. This evaluation is essential, as the sustainability of life depends on the suitability of land use concerning its physical conditions. Nine land units were identified with key limiting variables including slope gradient, soil texture and depth, permeability, drainage, and erosion level. Among the nine designated land units, Class II land capability is the most extensive, with 1,171.371 hectares, located in settlements including Simpang Selayang, Mangga, and Tanjung Selamat. This Class II property is deemed fruitful but has modest limitations, including moderate drainage and tiny rocks, with the primary impediment being the slope gradient. Therefore, this feature requires diligent management, including basic soil conservation techniques, such as fertilizer application or crop rotation. Conversely, land capability class IV is the least extensive, encompassing 67,483 hectares, located in communities such as Sidomulyo and Kemenangan Tani. Class IV topography exhibits more constraints and risks of degradation compared to Class III, characterized by heightened erosion potential, steep gradients, and shallow or unproductive soil. Class IV land management requires diligent supervision and more complex soil conservation techniques, such as the implementation of bench terraces, vegetated channels, or check dams. This study offers a substantial contribution to the management of designated land areas and is anticipated to serve as a crucial reference in conservation-oriented land use planning, aiding local governments in formulating sustainable spatial policies and directing communities in the selection of suitable land use systems.

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