Prosiding Seminar Nasional Pembangunan dan Pendidikan Vokasi Pertanian
Manokwari, 7 Juli 2026
e ISSN : 2774-1982
DOI: https://doi.org/10.47687/snppvp.v7i1.2322

Soil Physical Characteristics and Erosion Potential for Urban Agricultural Land Conservation in Samarinda Ilir

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Abstrak

Pemanfaatan lahan pertanian perkotaan di Samarinda Ilir menghadapi keterbatasan lahan dan meningkatnya potensi erosi pada kawasan lereng. Penelitian ini bertujuan menganalisis sifat fisik tanah dan potensi erosi sebagai dasar penyusunan arahan konservasi tanah dan air untuk mendukung pertanian perkotaan. Penelitian menggunakan metode deskriptif kualitatif melalui observasi lapangan di Kelurahan Pelita dan lereng Kuburan Cina Street, Kecamatan Samarinda Ilir. Data diperoleh melalui pengamatan sifat fisik tanah, kondisi vegetasi, topografi, pengelolaan lahan, dan dokumentasi. Hasil penelitian menunjukkan bahwa tanah di Kelurahan Pelita masih berpotensi dimanfaatkan untuk pertanian pekarangan, namun memerlukan penambahan bahan organik dan pengurangan pemadatan tanah. Sementara itu, lereng Kuburan Cina memiliki potensi erosi tinggi akibat lereng curam, minim vegetasi, dan belum diterapkannya tindakan konservasi. Oleh karena itu, diperlukan upaya konservasi berupa perbaikan kualitas tanah, revegetasi, saluran kontur, rorak, mulsa, serta pemantauan lereng secara berkala.

Kata kunci: Konservasi Tanah, Lahan Pertanian Perkotaan, Sifat Fisik Tanah, Tutupan Vegetasi, Erosi

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Abstract

Urban agricultural land in Samarinda Ilir faces limited land availability and increasing erosion risk on sloping areas. This study aimed to analyze soil physical properties and erosion potential as a basis for developing soil and water conservation strategies to support urban agriculture. A descriptive qualitative approach was employed through field observations in Pelita Village and the Kuburan Cina Street slope, Samarinda Ilir District. Data were collected by observing soil physical properties, vegetation cover, topography, land management, and field documentation. The results showed that the soil in Pelita Village has the potential for urban farming but requires the addition of organic matter and reduced soil compaction. In contrast, the Kuburan Cina slope exhibits a high erosion risk due to steep slopes, sparse vegetation, and the absence of conservation measures. Therefore, soil conservation efforts should include soil quality improvement, revegetation, contour drainage, infiltration pits, mulching, and regular slope monitoring.

Keywords: Soil Conservation, Urban Agricultural Land, Soil Physical Properties, Vegetation Cover, Erosion

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INTRODUCTION

Urban agriculture is increasingly relevant in Indonesian cities because household yards, small vacant plots, and community gardens can contribute to local food availability while strengthening environmental functions at the neighborhood scale. In Samarinda Ilir, this potential is accompanied by complex land-management constraints. Open soil in densely settled areas is increasingly limited by buildings, asphalt surfaces, and paved yards, whereas hilly corridors that have been cut for access roads often expose unstable soil and rock materials. These contrasting conditions require an integrated reading of soil quality and erosion susceptibility before land can be recommended for agricultural or garden-based use.

Soil physical characteristics provide an initial indicator of land capability for cultivation. Color, texture, structure, consistency, porosity, and soil profile development influence root penetration, water retention, aeration, infiltration, and aggregate stability. Syahputera et al. (2024) emphasize that physical and chemical characteristics of Ultisols on plantation land are interconnected in determining soil quality, while Septiaji et al. (2024) show that slope gradient is associated with variation in Ultisol physical properties, including permeability, aggregate stability, water retention, and erosion sensitivity. At the site scale, such physical properties cannot be separated from land use because compaction, filling, excavation, trampling, and construction activities can alter surface soil structure and porosity. Bintoro et al. (2017) also demonstrated that soil physical properties differ across land-use types, and Nurhartanto et al. (2022) positioned soil physical indicators as an early diagnostic basis for identifying soil degradation on dry land.

Soil erosion is one of the major forms of land degradation affecting agricultural sustainability. Aisyah et al. (2022) identify soil erosion as a key driver of land degradation that can be reduced through appropriate land-cover planning. Studies using GIS-based USLE or RUSLE models in Indonesian watersheds show that slope gradient, land cover, soil erodibility, and rainfall erosivity are decisive factors influencing soil loss (Hadi et al., 2023; Lasaiba et al., 2023; Yusuf et al., 2020). Although spatial modeling provides strong quantitative outputs, micro-scale field studies remain necessary for identifying early symptoms of soil damage, particularly in sites where laboratory datasets, detailed slope measurements, and high-resolution erosion maps are not yet available.

The urban landscape of Samarinda Ilir shows sharp site-level contrasts. On the one hand, small open plots between dense settlements can still be managed as productive home

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gardens if their soil media are improved. On the other hand, artificial slopes formed by hill cutting may threaten nearby roads, settlements, and community gardens when surface runoff is not controlled. These two settings demand different conservation strategies. Home-garden soils require improvement of planting media, moisture retention, and infiltration, whereas exposed slopes require runoff control, surface stabilization, and revegetation. Fuady et al. (2014) found that vegetative soil conservation can reduce runoff, erosion, and nutrient loss, while Nifen and Idris (2021) showed that vegetation cover is closely related to reduced erosion risk in upstream river areas.

Previous research has widely discussed erosion at the watershed scale, in reclamation areas, or across broad land units (Anggraini et al., 2019; Farikha et al., 2023; Maghribie, 2023; Sarminah et al., 2023). However, studies that combine the diagnosis of home-garden soil physical properties with the field assessment of urban slope erosion potential remain limited. Such combined diagnosis is important for agrotechnology extension, community garden management, and early mitigation of land degradation in residential areas. Therefore, this study aimed to analyze the physical characteristics of soil in Pelita Subdistrict and the erosion potential of the Kuburan Cina slope, and to formulate soil and water conservation recommendations for urban agricultural land and community gardens in Samarinda Ilir.

METHOD

This study used a qualitative descriptive method based on direct field observation. The method was selected because the research was designed to describe soil physical conditions, erosion-triggering factors, and conservation needs at two contrasting sites rather than to quantify soil-loss rates. The first site was located at Jalan Lambung Mangkurat Gang 9 RT 12 Number 50, Pelita Subdistrict, Samarinda Ilir District, Samarinda Ilir City, East Kalimantan. This site represents a small open soil area within a dense residential environment with relatively flat micro-topography and surrounding surfaces dominated by buildings, asphalt roads, and paved yards. The second site was located along the Kuburan Cina Street corridor, Sungai Pinang Dalam Subdistrict, Samarinda Ilir District, at approximately 0.49130 S and 117.17030 E. This site represents a cut hill slope adjacent to access roads, settlements, and community garden activities.

Data collection at the Pelita site involved sampling the upper soil layer at a depth of 0-10 cm. The observed parameters included soil color, texture, structure, wet-moist-dry consistency, and soil profile. Soil color was identified using the Munsell Soil Color Chart,

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while texture and consistency were determined through simple field tests based on touch, plasticity, stickiness, and aggregate response. Soil structure was observed from aggregate shape and size. Environmental observations also recorded the scarcity of open soil, the presence of low vegetation, paved surfaces, and possible anthropogenic disturbances.

Data collection at the Kuburan Cina site was conducted through visual observation of slope morphology, exposed soil and rock materials, vegetation cover, topography, indications of runoff flow, and land-management practices. The recorded aspects included the presence of cut slopes, exposed soil and rock surfaces, accumulated eroded material at the slope foot, drainage conditions, and the presence or absence of terraces, infiltration pits, contour drainage, retaining structures, or other soil conservation measures. Field photographs were used to strengthen site interpretation and to support the visual assessment of erosion susceptibility.

Data were analyzed descriptively and comparatively. Data from Pelita Subdistrict were used to assess the initial suitability of the observed soil as a medium for home-garden cultivation, whereas data from the Kuburan Cina corridor were used to identify factors contributing to slope erosion potential. Interpretation was conducted by linking field findings with literature on soil physical properties, erodibility, vegetation cover, and soil and water conservation techniques. The analysis was synthesized into conservation recommendations differentiated between flat home-garden plots and sloping community-garden or access-road corridors.

RESULTS AND DISCUSSION

Characteristics of The Study Sites

The two research sites displayed clearly different site characteristics. Pelita Subdistrict is a dense residential environment where open soil is extremely limited. The observable soil area consisted of a small yard or vacant spot between buildings and hardened surfaces. This condition indicates that the soil may have been affected by anthropogenic disturbance such as trampling, filling, excavation, construction-material mixing, and reduced infiltration space. Nevertheless, the remaining open soil is still important because it can function as a medium for home-garden agriculture if its physical quality is improved.

In contrast, the Kuburan Cina site is a cut-slope corridor in a hilly area. The slope appeared steep, open, and composed of soil and rock materials that can be detached and transported by surface runoff. Accumulated eroded materials were observed at the foot of

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DOI: https://doi.org/10.47687/snppvp.v7i1.2322

the slope. This condition indicates that the site faces not only land-productivity issues but also road-access safety and sustainability concerns for nearby community gardens. The contrasting characteristics of the two sites are summarized in Table 1.

Table 1. Synthesis of Study-Site Characteristics

Aspect	Pelita Subdistrict	Kuburan Cina Street	Agricultural Implication
Landform	Flat, small yard in a residential area	Cut slope along an access corridor	Requires different conservation strategies
Surface cover	Many paved and built-up surfaces	Open slope face with exposed material	Low infiltration and increased runoff
Vegetation	Limited grass and low vegetation	Sparse protective cover on the slope face	Ground cover and revegetation are needed
Conservation focus	Improvement of planting media and infiltration	Erosion control and slope stabilization	Supports productive yards and community gardens

Source: Primary field observation, 2026

Soil physical characteristics in Pelita Subdistrict

The observed soil in Pelita Subdistrict had a brown color with the Munsell code 7.5 YR 4/4. Brown color in tropical soils is generally associated with mineral weathering and the presence of iron oxides under relatively well-aerated conditions. In the context of home-garden agriculture, this color suggests that the observed sample represents mineral topsoil; however, color alone cannot determine fertility status. Further analysis of pH, organic matter, cation exchange capacity, nitrogen, phosphorus, and potassium is still required to evaluate crop suitability more comprehensively.

The soil texture was classified as moderately coarse. This characteristic indicates that sand or relatively coarse particles were more dominant than clay fractions. Moderately coarse soil generally drains more quickly but retains less water and nutrients than medium-textured soil. Syahputera et al. (2024) showed that physical and chemical parameters, including texture, moisture content, bulk density, and nutrient-related properties, jointly shape soil quality in plantation land. For home-garden agriculture, moderately coarse texture should therefore be balanced by organic matter amendment, mulch application, and ground cover so that soil moisture becomes more stable.

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The soil structure was identified as very coarse angular blocky, with an aggregate size of approximately 20 mm. Angular blocky structure indicates the presence of aggregation, but very coarse aggregates are not ideal for fine-root development. This condition may result from wetting-drying cycles, root activity, soil organisms, and human disturbance. In residential land, soil structure is often altered by foot traffic, filling, excavation, or construction activity. The findings of Bintoro et al. (2017), which show differences in soil physical properties among land-use types, support the interpretation that spatial-use change can alter surface-soil characteristics.

Table 2. Soil Physical Characteristics ff The Pelita Subdistrict Sample

Parameter	Observation Result	Agronomic Interpretation	Initial Recommendation
Color	Brown, 7.5 YR 4/4	Mineral topsoil with active weathering indication	Test pH, organic matter, and nutrients
Texture	Moderately coarse	Relatively rapid drainage; water and nutrient retention need improvement	Apply compost, mulch, and rice husk
Structure	Very coarse angular blocky, approximately 20 mm	Large aggregates are less ideal for fine roots	Use shallow tillage and organic matter
Consistency	Non-plastic but sticky when wet; very friable when moist; soft when dry	Good root space when moist, but low cohesion when dry	Keep the soil surface covered
Profile	Mineral A horizon	Topsoil can still function as planting media	Manage beds and reduce compaction

Source: Primary field observation, 2026.

Soil consistency was non-plastic but sticky under wet conditions, very friable under moist conditions, and soft under dry conditions. This combination is consistent with moderately coarse texture and low plasticity. Very friable moist soil can support root penetration, but soft dry consistency indicates weak cohesion. If the soil is left exposed, aggregates may be broken by raindrop impact and fine particles may be displaced as

e ISSN : 2774-1982
DOI: https://doi.org/10.47687/snppvp.v7i1.2322

sediment. Injiliana et al. (2020) showed that soil erodibility varies according to land cover; therefore, maintaining surface cover is a key management step even in small home-garden plots. Documentation of the Pelita soil observation is presented in Figure 1.

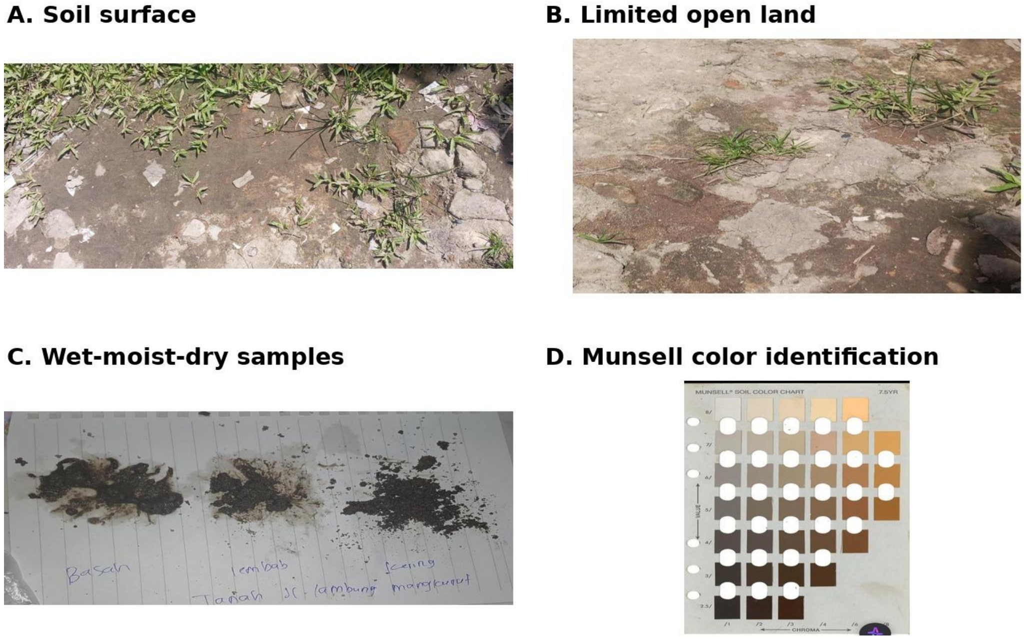

Figure 1. Documentation of soil observation in Pelita Subdistrict
(Source: Primary documentation, 2026)

Erosion Potential on the Kuburan Cina Slope

The Kuburan Cina slope showed stronger erosion-triggering factors than the Pelita site. The topography consists of an artificial cut slope with exposed soil and rock surfaces. Under high rainfall conditions, exposed slopes receive direct raindrop impact energy. Water then moves downslope as surface runoff, detaches soil particles, and transports material to the slope foot or road surface. This is consistent with Farikha et al. (2023), who found that land use and slope condition influence erosion hazard indices.

Visually, the upper slope layer was dominated by yellowish-brown soil, interpreted in field observation as being close to the characteristics of Red-Yellow Podzolic soil or Ultisol. In the middle to lower part of the slope, a dark grayish sedimentary layer was observed and reported to become slippery when wet. This characteristic is important because material behavior under wet conditions can reduce slope stability. Septiaji et al. (2024) explain that Ultisols may have slow permeability and low aggregate stability, making them susceptible to erosion. Surface-water control and improved soil cover are therefore priorities at this site.

e ISSN : 2774-1982
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Protective vegetation on the slope face was sparse. Remaining vegetation occurred mainly on the slope top or margins and consisted of shrubs, wild grasses, and edge trees. This cover was insufficient to slow runoff across the entire slope surface. Nifen and Idris (2021) showed that vegetation density affects erosion, and Fuady et al. (2014) demonstrated that vegetative conservation can reduce runoff, erosion, and nutrient loss. Thus, slope revegetation should be treated as an urgent conservation requirement rather than as a purely aesthetic intervention.

The main problem at the Kuburan Cina site is the interaction of steep cut-slope morphology, high rainfall, limited vegetation cover, easily detached material, and inadequate conservation infrastructure. No terracing, directed drainage, infiltration pits, or retaining structures were identified on the most exposed slope sections. These conditions may increase sheet erosion, rill erosion, and shallow mass movement. Slope documentation is shown in Figure 2.

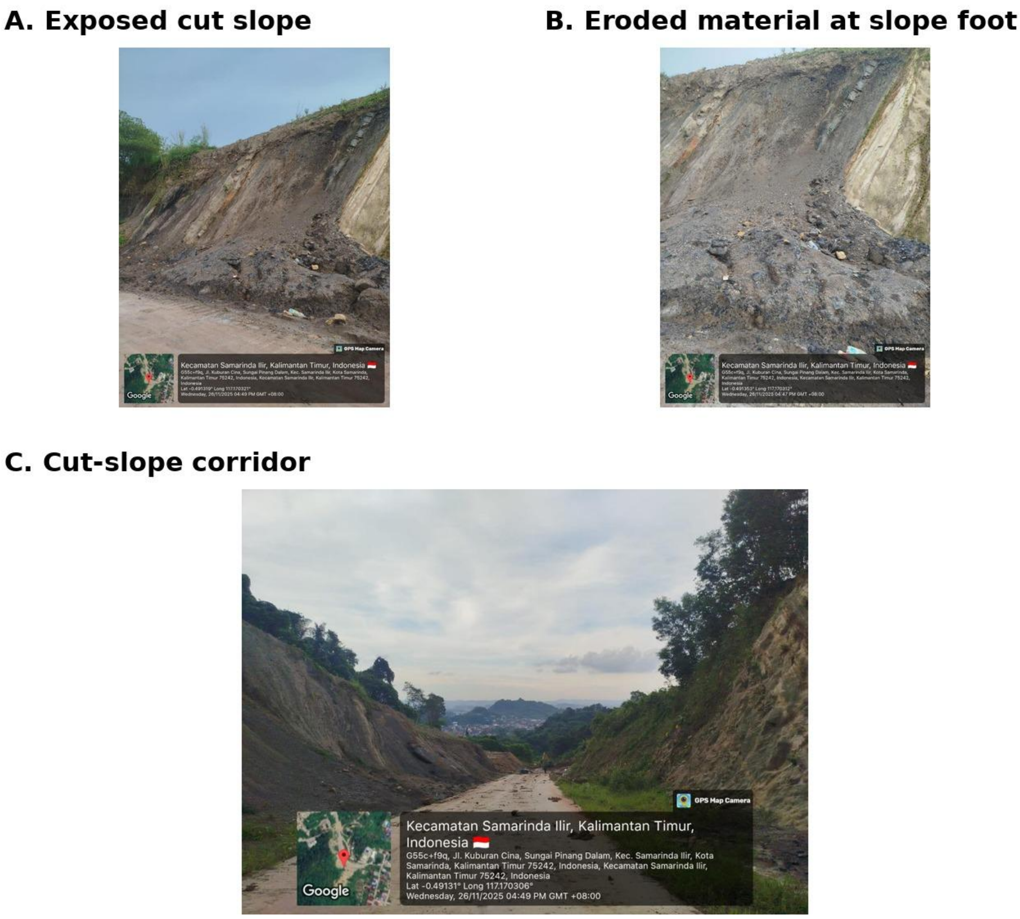

Figure 2. Slope condition and eroded materials along Kuburan Cina Street
(Source: Primary documentation, 2026)

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Conservation Recommendations for Urban Agriculture and Community Gardens

The synthesis of the two sites indicates that soil conservation strategies in Samarinda Ilir must be differentiated according to site conditions. In flat home-garden plots, conservation should focus on improving planting media and infiltration capacity. On exposed slopes, conservation should focus on reducing runoff energy, stabilizing the surface, and strengthening soil through vegetation. This distinction is essential because interventions that are effective in a small yard may not be sufficient for a steep slope, while mechanical slope-control structures may not be relevant for limited home-garden soil.

For the Pelita site, recommended practices include applying mature compost, organic mulch, rice husk, and leaf litter to improve aggregation and moisture retention. Raised planting beds can be established with fixed walking paths to prevent repeated compaction in root zones. Low ground-cover plants should be maintained in areas not used for planting to reduce direct raindrop impact. These strategies support home-garden agriculture because moderately coarse texture and very coarse angular blocky structure require organic inputs to become a more stable medium for vegetables, medicinal plants, and small fruit crops.

For the Kuburan Cina site, vegetative conservation should be the first priority. Revegetation can be implemented using slope-strengthening grasses, ground-cover plants, local shrubs, and deep-rooted plants in safe zones. Plant selection should consider slope loading, root depth, maintenance needs, and tree-fall risk. Nurida et al. (2018) showed that agroforestry models have potential for rehabilitating degraded land in East Kalimantan, while Akbar (2021) recommended agroforestry conservation, cover crops, mulch, terraces, and reforestation to reduce erosion in risk-prone land.

Simple mechanical conservation is also needed on the Kuburan Cina slope. Drainage channels should be aligned along contour directions and equipped with energy dissipaters so that runoff does not directly attack the slope face. Where feasible, infiltration pits, contour bunds, small terraces, and routine removal of sediment from the slope foot can reduce effective slope length and slow runoff. Anggraini et al. (2019), Sarminah et al. (2023), and Mirza et al. (2023) underline the importance of erosion hazard assessment and land-use guidance for determining appropriate conservation measures. A summary of recommendations is presented in Table 3.

This study is limited by the absence of quantitative measurements of erosion rate, permeability, bulk density, organic matter content, aggregate stability, and slope gradient.

e ISSN : 2774-1982
DOI: https://doi.org/10.47687/snppvp.v7i1.2322

Therefore, the findings should be positioned as an initial field diagnosis. Future studies should integrate laboratory soil analysis, infiltration tests, topographic mapping, rainfall analysis, and sediment monitoring after rainfall events. Such quantitative approaches would strengthen conservation recommendations and support the development of agrotechnology extension packages for home gardens, community gardens, and urban slopes in Samarinda Ilir.

Table 3. Soil and Water Conservation Recommendations Based on Field Observation

Main problem	Priority location	Conservation recommendation	Expected impact
Moderately coarse yard soil that dries quickly	Pelita Subdistrict	Compost, mulch, rice husk, organic beds, fixed walking paths	Improved moisture and aggregate stability
Exposed soil surface	Pelita and Kuburan Cina	Ground-cover plants, litter cover, low grasses	Reduced direct raindrop impact
Steep cut slope	Kuburan Cina Street	Gradual revegetation using strong-rooted local plants	Roots help reinforce surface soil
Uncontrolled runoff	Kuburan Cina Street	Contour channels, infiltration pits, energy dissipaters, sediment removal	Reduced runoff velocity and rill erosion
Limited slope-protection structures	Kuburan Cina Street	Technical evaluation for retaining walls or slope-support structures at critical points	Reduced landslide risk and road blockage

Source: Synthesis of field observation and literature review, 2026.

CONCLUSION

The integration of two mini-research datasets shows that soil conservation problems in Samarinda Ilir are micro-site specific. The open soil observed in Pelita Subdistrict had a brown color of 7.5 YR 4/4, moderately coarse texture, very coarse angular blocky structure of approximately 20 mm, non-plastic but sticky wet consistency, very friable moist consistency, soft dry consistency, and a mineral A horizon. These characteristics indicate that the soil can still be used for home-garden cultivation, but it

e ISSN : 2774-1982
DOI: https://doi.org/10.47687/snppvp.v7i1.2322

requires organic matter amendment, mulching, reduced compaction, and bed management to improve infiltration and root-zone function.

The Kuburan Cina slope exhibited higher erosion potential because of the combination of cut-slope morphology, exposed soil and rock materials, sparse vegetation cover, accumulated eroded material at the slope foot, and the absence of terraces, contour drainage, infiltration pits, or retaining structures at critical points. The most relevant conservation directions include gradual revegetation using strong-rooted local plants, ground-cover establishment, runoff control through contour channels and infiltration pits, and technical evaluation of slope sections with potential shallow landslide risk. These findings position soil conservation as part of urban agriculture support, community garden protection, and local food-resilience efforts.

The study is limited to descriptive observation and field documentation; therefore, it does not yet produce numerical erosion rates or laboratory-based soil parameters. Further research should measure slope gradient, infiltration, bulk density, permeability, laboratory texture, organic matter, and post-rainfall sediment change. With these quantitative data, conservation recommendations can be developed into more precise agrotechnology extension packages for home gardens, community gardens, and urban slopes in Samarinda Ilir.

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