

**PROPOSAL
HIBAH PENELITIAN INTERNAL
BERBASIS RENSTRA PENELITIAN DAN PKM 2026–2030**



JUDUL PENELITIAN

A GIS-Based Source-to-Sink Framework Integrating RUSLE and Sediment Connectivity Index for Assessing Soil Erosion and Sediment Yield Potential in Tropical Watersheds

Ketua Tim: Dr. Ir. Muhammad Ramdhan Olli, ST., M.Eng.

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Program Studi/Fakultas: Teknik Sipil/Teknik

**LEMBAGA PENELITIAN, PENGEMBANGAN, DAN PENGABDIAN KEPADA
MASYARAKAT (LP3M)
UNIVERSITAS GORONTALO
2026**

A. IDENTITAS USULAN

Judul Penelitian	A GIS-Based Source-to-Sink Framework Integrating RUSLE and Sediment Connectivity Index for Assessing Soil Erosion and Sediment Yield Potential in Tropical Watersheds
Ketua Tim	Nama: Dr. Ir. Muhammad Ramdhan Olii, ST., M.Eng. NIDN/NIDK/NUPTK: 0924058701 Program Studi/Fakultas: Teknik Sipil/Teknik
Anggota Tim	1. Dr. Ririn Pakaya, SKM., MPH. 2. Dr. Ir. Roby Hambali, ST., M.Eng. 3. Rizky Selly Nazarina Olii, ST., M.Si.
Mahasiswa yang terlibat (jika ada)	1. Tegar Aditya Buchari Kai 2. Moh. Saputra Dunggio
Kelompok Riset (jika sudah terbentuk)	.....
Lama Pelaksanaan	.6 bulan
Dana yang Diusulkan	Rp 12.500.000

B. KESESUAIAN DENGAN RENSTRA PENELITIAN DAN PKM

Bagian ini dibuat singkat agar setiap proposal dapat langsung dipetakan pada arah penelitian Universitas Gorontalo.

Bidang/Rumpun Unggulan	☐ Pertanian & Pangan ☐ Perikanan & Kelautan ☒ Lingkungan ☐ Kesehatan ☐ Pendidikan ☐ Ekonomi & UMKM ☐ Pariwisata ☐ Teknologi & Digitalisasi ☐ Sosial Budaya ☐ Pembangunan Desa ☐ Lainnya:
Tema	<i>Integrated Watershed Management for Soil Erosion Control and Water Resources Resilience</i> Pengelolaan DAS Terpadu untuk Pengendalian Erosi dan Ketahanan Sumber Daya Air
Subtema	<i>Sediment Connectivity and Source-to-Sink Dynamics</i> Konektivitas Sedimen dan Dinamika Source-to-Sink pada DAS
Tahap dalam Roadmap	☒ Identifikasi/Baseline ☐ Eksploratif/Dasar ☐ Terapan ☐ Pengembangan ☐ Validasi ☐ Proteksi HKI ☐ Hilirisasi/Pemanfaatan ☐ Dampak
Keterkaitan dengan Potensi/Permasalahan Gorontalo	Menjawab permasalahan degradasi lahan, erosi, sedimentasi, dan pengelolaan DAS di Gorontalo melalui pemetaan sumber erosi, konektivitas sedimen, dan potensi sediment yield sebagai dasar penentuan prioritas konservasi tanah dan air.
Keterkaitan dengan SDGs (jika relevan)	SDG 6 – Clean Water and Sanitation (Target 6.6) dan SDG 15 – Life on Land (Target 15.3) , melalui perlindungan ekosistem DAS, pengendalian erosi dan sedimentasi, serta penanganan degradasi lahan.
Sifat Penelitian	☐ Individual ☐ Kelompok Riset ☒ Lintas Prodi/Multidisiplin ☐ Kolaborasi dengan Mitra

C. RINGKASAN

Tuliskan masalah, tujuan, metode, luaran utama, serta kontribusi penelitian terhadap roadmap. Maksimal 300 kata.

Soil erosion and sedimentation are major challenges in watershed management, particularly in tropical regions characterized by high rainfall intensity, varied topography, land-use change, and intensive agricultural activities. Although the RUSLE model is widely used to estimate spatial soil loss, it does not directly explain how much eroded material is connected to and delivered into river networks. Therefore, this study aims to: (1) map the spatial distribution of soil erosion using RUSLE; (2) analyze sediment connectivity and the Sediment Delivery Ratio (SDR) using the Index of Connectivity; (3) estimate sediment yield potential; and (4) identify critical source–pathway–sink zones for watershed management prioritization. The study applies a GIS-based source-to-sink framework integrating DEM, rainfall, soil, and land-cover data. The analysis combines RUSLE modelling, Sediment Connectivity Index, SDR estimation, sediment yield potential assessment, and spatial overlay analysis to identify conservation priority areas. ArcGIS Pro and Python-based geospatial processing are used to support the analysis. The main outputs include soil erosion maps, sediment connectivity maps, sediment yield potential maps, conservation priority zones, a watershed geospatial database, and a scientific publication. Within the 2026–2030 research roadmap, this study is positioned at the **Identification/Baseline – KNOW: Baseline & Mapping** stage. It provides the scientific and spatial foundation for subsequent studies on sediment yield, erosion–hydrology–water resources interactions, watershed conservation, Nature-Based Solutions, and AI-based watershed decision support systems.

Kata Kunci: Soil erosion; RUSLE; Sediment connectivity; Sediment yield; Watershed management.

D. LATAR BELAKANG DAN PERMASALAHAN

Jelaskan secara ringkas: masalah yang diteliti, kondisi/temuan sebelumnya, alasan pentingnya penelitian, serta kaitannya dengan potensi atau kebutuhan daerah dan/atau bidang keilmuan. Maksimal 2 halaman.

Soil erosion by water is one of the major environmental challenges affecting watershed sustainability, particularly in tropical regions where high rainfall intensity, steep terrain, and rapid land-use changes accelerate soil degradation and sediment transport processes. Excessive soil erosion not only reduces land productivity but also increases sediment delivery to river systems, causing reservoir siltation, declining water quality, and disruption of aquatic ecosystems. Therefore, understanding the spatial relationship between soil erosion generation and sediment transport pathways is essential for developing effective soil and water conservation strategies. The Revised Universal Soil Loss Equation (RUSLE) has been widely applied to estimate spatial patterns of soil loss by integrating rainfall erosivity, soil erodibility, topography, vegetation cover, and conservation practices (Renard et al., 1997). However, soil erosion estimates derived from RUSLE represent gross erosion occurring at the hillslope scale and do not directly quantify the proportion of eroded materials that are transported and delivered to river channels. Consequently, erosion assessment alone may overestimate sediment-related risks because sediment movement is strongly controlled by landscape connectivity and transport processes within watersheds (Borselli et al., 2008; Vigiak et al., 2012).

Recent advances in Geographic Information Systems (GIS) and remote sensing have enabled more comprehensive approaches for investigating sediment dynamics by integrating erosion modelling with sediment connectivity analysis. Sediment connectivity represents the degree to which sediment

sources are linked to downstream sinks through landscape pathways, considering both topographic characteristics and surface conditions (Borselli et al., 2008). The Index of Connectivity (IC) has become an effective approach for quantifying sediment transfer potential because it incorporates upslope contributing areas and downslope transport resistance, providing spatial information on areas that are more likely to contribute sediment to river networks (Cavalli et al., 2013). Previous studies have demonstrated that combining RUSLE with IC and Sediment Delivery Ratio (SDR) models can improve understanding of sediment generation and delivery processes compared with erosion-only approaches (Guo et al., 2023; Singh et al., 2025). Nevertheless, several limitations remain. Many existing studies have focused on temperate or semi-arid environments, while tropical watersheds with complex land-cover dynamics and intensive agricultural activities remain relatively underrepresented. Furthermore, previous studies frequently emphasize total soil loss estimation without explicitly identifying the spatial transition from erosion source areas, sediment transport pathways, and sediment export zones within a unified framework.

The Paguyaman Watershed in Gorontalo Province, Indonesia, represents a typical tropical watershed experiencing increasing pressure from agricultural expansion, land-use transformation, and variable topographic conditions. These characteristics create complex interactions between erosion processes, sediment transport, and downstream sediment accumulation. Although GIS-based erosion assessments have been widely implemented in Indonesian watersheds, studies integrating erosion magnitude with sediment connectivity and sediment delivery mechanisms at grid scale remain limited, particularly in tropical agricultural watersheds. This research addresses this gap by proposing a **GIS-based source-to-sink framework** that integrates RUSLE, Index of Connectivity (IC), and Sediment Delivery Ratio (SDR) to assess soil erosion and sediment yield potential (**Figure 1**). Unlike conventional erosion mapping approaches that only identify areas with high soil loss, the proposed framework links three sequential processes: (1) sediment generation from erosion-prone areas (**source**), (2) sediment transfer through landscape connectivity (**pathway**), and (3) potential sediment delivery to drainage networks (**sink**). This process-based approach provides a more realistic representation of watershed sediment dynamics, especially in data-limited regions where field sediment monitoring is unavailable. Previous applications of RUSLE–SDR frameworks have demonstrated their capability for spatially distributed sediment yield assessment using remote sensing and GIS data, providing valuable information for watershed management and conservation prioritization (Majhi et al., 2023; Vigiak et al., 2012).

Therefore, the novelty of this study lies in the development of an integrated **source-to-sink sediment assessment framework** that combines remotely sensed environmental information, RUSLE-based erosion estimation, and connectivity-based sediment delivery modelling at a fine spatial scale for a tropical watershed. This approach moves beyond conventional erosion susceptibility mapping by quantifying how landscape structure controls the transformation of eroded soil into potential sediment yield. The framework is expected to provide new insights into critical sediment source areas and sediment transport pathways in the Paguyaman Watershed, supporting targeted soil and water conservation planning.

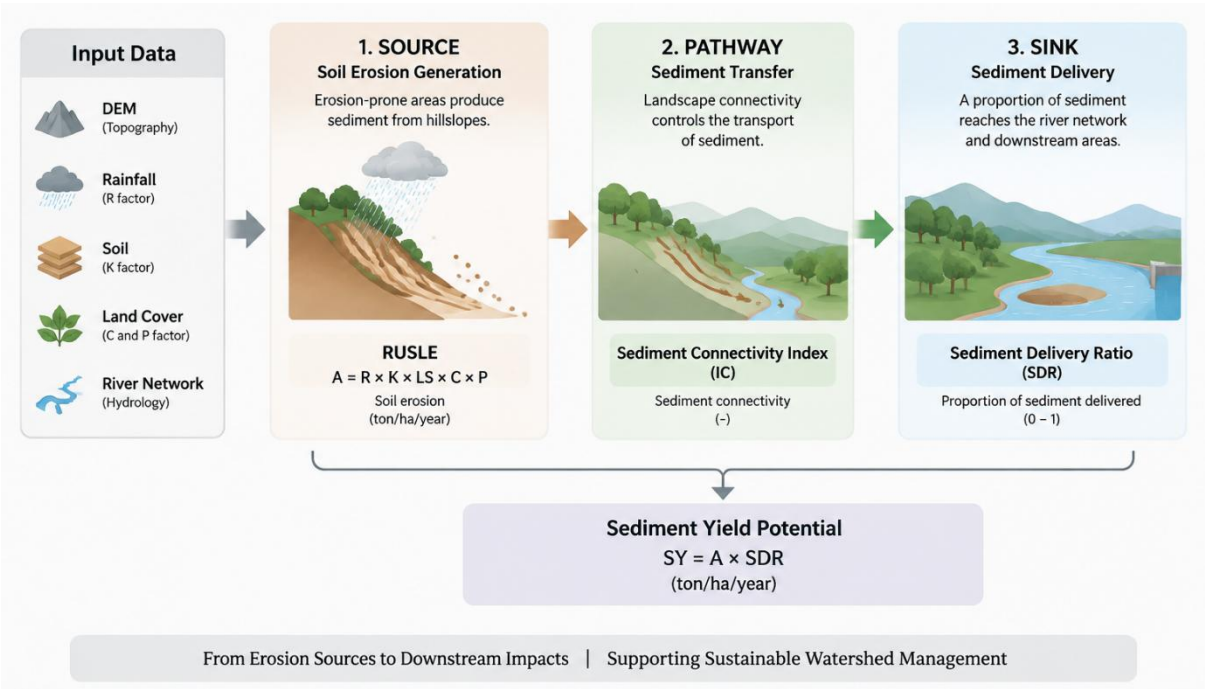


Figure 1. Conceptual framework illustrating the integration of RUSLE-based soil erosion modelling, sediment connectivity analysis, and sediment delivery estimation for assessing sediment yield potential using a GIS-based source-to-sink approach.

E. POSISI PENELITIAN DALAM ROADMAP

Tidak perlu membuat roadmap panjang. Cukup tunjukkan penelitian ini berada di tahap mana, berasal dari penelitian apa, dan akan dilanjutkan ke arah apa.

Penelitian/temuan sebelumnya yang menjadi dasar	Previous erosion studies have demonstrated that RUSLE is effective for estimating spatial patterns of soil loss; however, RUSLE represents gross hillslope erosion and does not directly explain how much eroded material is transferred to river networks. Recent studies have therefore integrated soil erosion modelling with the Sediment Connectivity Index (IC) and Sediment Delivery Ratio (SDR) to better represent sediment transfer processes. The Paguyaman Watershed is characterized by agricultural expansion, land-use change, varied topography, and susceptibility to erosion and sediment transport, providing a strong basis for developing an integrated source-to-sink assessment framework.
Posisi penelitian tahun ini	This study is positioned at the Identification/Baseline – KNOW: Baseline & Mapping stage of the research roadmap. It develops a GIS-based source-to-sink framework integrating RUSLE, Sediment Connectivity Index, and SDR to identify sediment sources, transfer pathways, sediment delivery potential, and critical source-to-sink zones in the Paguyaman Watershed. The study therefore establishes the spatial and methodological baseline required for subsequent sediment-yield, hydrological-response, and watershed-management studies..
Rencana pengembangan berikutnya	The next stage will advance from baseline mapping toward quantitative sediment-yield assessment and watershed degradation analysis , followed by integration with hydrological modelling to examine the relationships among land-use change, erosion, sedimentation, runoff, flood/drought processes, and water-resource vulnerability. Subsequent development will include conservation-priority modelling, Nature-Based Solutions, field validation, and ultimately an AI/GIS-based decision-support system for integrated watershed management. The present source-to-sink framework will serve as the foundational dataset and analytical platform for these future stages.

Kontribusi terhadap bidang/tema/kelompok riset	This research contributes directly to the field of Environment and Natural Resources , particularly the theme Watersheds and Water Resources , and to the research roadmap theme Integrated Watershed Management for Soil Erosion Control and Water Resources Resilience . Its main subtheme is Sediment Connectivity and Source-to-Sink Dynamics , supported by Soil Erosion Assessment and Land Degradation . Scientifically, the study contributes a process-based framework linking erosion source → sediment connectivity → transport pathway → sediment delivery → sediment yield potential , providing a stronger basis for soil and water conservation and sustainable watershed management.
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F. TUJUAN DAN MANFAAT

1. Tujuan

- To assess the spatial distribution and magnitude of soil erosion in the Paguyaman Watershed using the Revised Universal Soil Loss Equation (RUSLE) within a GIS-based framework.
- To quantify sediment connectivity, sediment delivery ratio, and sediment yield potential by integrating the Index of Connectivity (IC) with source-to-sink spatial analysis.
- To identify critical sediment source areas, transport pathways, and priority zones for soil and water conservation as a basis for sustainable watershed management.

2. Manfaat

This research is expected to provide a comprehensive spatial understanding of the relationships among **soil erosion, sediment connectivity, sediment transport, and sediment yield potential** in a tropical watershed.

The results will provide scientific and spatial information for identifying **critical erosion and sediment source areas**, thereby supporting more targeted soil and water conservation planning and watershed rehabilitation.

In addition, the proposed GIS-based source-to-sink framework can serve as a practical decision-support basis for **sustainable watershed management, sediment control, and conservation prioritization**, particularly in data-limited tropical watersheds.

G. METODE PENELITIAN

Jelaskan secara sederhana dan sesuai karakter penelitian: desain/pendekatan, subjek/objek atau sumber data, tahapan penelitian, teknik pengumpulan data, dan analisis data. Maksimal 2 halaman.

Study Area

This study was conducted in the Paguyaman Watershed, Gorontalo Province, Indonesia, a tropical watershed characterized by diverse topographic conditions, agricultural activities, forest areas, and dynamic land-use changes. The watershed was selected due to its susceptibility to soil erosion and sediment transport processes associated with intensive land utilization and varying landscape characteristics. The research applied a spatial modelling approach based on the source–pathway–sink concept, where eroded soil represents the sediment source, landscape connectivity represents the transport pathway, and sediment yield potential represents the downstream sink response. All spatial analyses were performed using ArcGIS Pro, while raster processing and model automation were supported by Python-based geospatial libraries.

Data Acquisition and Pre-processing

A multi-source geospatial dataset was integrated to develop the erosion and sediment delivery model. The required datasets included Digital Elevation Model (DEM), rainfall data, soil properties,

and land-cover information. DEM data with a spatial resolution of 30 m were used to derive elevation, slope, flow direction, flow accumulation, and watershed boundaries. Rainfall data were obtained from satellite-based precipitation products to estimate rainfall erosivity, while soil characteristics were acquired from global soil databases to determine soil erodibility. Landsat 8 multispectral imagery was processed to generate vegetation indices for estimating surface cover conditions. All datasets were projected into the same coordinate system, resampled to a common spatial resolution, and converted into raster format to ensure spatial consistency during modelling.

Soil Erosion Estimation Using RUSLE Model

Annual soil loss was estimated using the Revised Universal Soil Loss Equation (RUSLE), which has been widely applied for spatial assessment of soil erosion under various environmental conditions (Renard et al., 1997). The RUSLE model was expressed as:

$$A = R \times K \times L \times S \times C \times P \quad (1)$$

where A represents annual soil loss ($\text{ton ha}^{-1} \text{ year}^{-1}$), R is rainfall erosivity, K is soil erodibility, LS represents slope length and slope steepness, C represents vegetation and land-cover management, and P represents conservation practices. Each factor was spatially derived using remote sensing and GIS-based approaches. The rainfall erosivity factor was calculated from rainfall characteristics, soil erodibility was assigned based on soil texture and properties, the L factor was derived from DEM analysis, while the C and P factors were determined from land-cover characteristics and conservation conditions. The resulting raster layer represented the spatial distribution of potential soil erosion within the Paguyaman Watershed.

Sediment Connectivity Analysis Using Index of Connectivity (IC)

Sediment connectivity was quantified using the Index of Connectivity (IC) proposed by Borselli et al. (2008), which describes the linkage between sediment sources and downstream sinks based on landscape characteristics. The IC approach considers both upslope contributing areas and downslope transport pathways, incorporating topographic and land-cover influences on sediment movement. The index was calculated as:

$$IC = \log_{10} \left(\frac{D_{up}}{D_{dn}} \right) \quad (2)$$

where D_{up} represents the upslope component associated with contributing area, slope, and land-cover conditions, while D_{dn} represents the downslope component related to flow-path length and resistance factors. Higher IC values indicate stronger sediment connectivity and greater potential for eroded materials to reach stream networks, whereas lower values indicate greater sediment retention within the landscape (Borselli et al., 2008; Cavalli et al., 2013).

Sediment Delivery Ratio (SDR) Estimation

The Sediment Delivery Ratio (SDR) was estimated to quantify the proportion of eroded soil that is potentially delivered to the drainage network. The SDR calculation followed the connectivity-based approach, where sediment delivery efficiency is controlled by the spatial relationship between sediment sources and receiving channels (Borselli et al., 2008). The spatially distributed SDR value for each grid cell was derived from the IC value using a logistic relationship between connectivity and sediment transport efficiency. This approach enables estimation of sediment delivery patterns without requiring extensive field sediment measurements and has been widely applied in data-limited watersheds using GIS-based modelling frameworks (Vigiak et al., 2012; Natural Capital Project, 2024).

Sediment Yield Potential Estimation

The sediment yield potential was estimated by integrating soil erosion intensity and sediment delivery efficiency. The spatially distributed sediment yield potential was calculated using the relationship:

$$SY = A \times SDR \quad (3)$$

where SY represents sediment yield potential, AA represents annual soil erosion estimated from the RUSLE model, and SDR represents the proportion of eroded sediment delivered to the stream network. This approach follows the source-to-sink sediment modelling framework, where sediment generation from hillslopes is linked with landscape connectivity processes to estimate potential sediment export at watershed scale (Borselli et al., 2008; Vigjak et al., 2012).

Source–Pathway–Sink Spatial Analysis

To identify critical sediment-producing areas, a source–pathway–sink analysis was conducted by integrating soil erosion intensity, sediment connectivity, and sediment yield potential maps. The source component was represented by areas with high soil erosion rates, the pathway component was represented by areas with high IC and SDR values indicating efficient sediment transport routes; and the sink component represented locations with high sediment accumulation potential near drainage networks. Spatial overlay analysis was performed to identify priority areas for soil and water conservation interventions. This framework provides a process-based interpretation of sediment movement rather than solely presenting erosion distribution patterns.

Conservation Priority Analysis

Conservation priority analysis was conducted to identify critical areas requiring soil and sediment management interventions by integrating soil erosion intensity, sediment connectivity, and sediment delivery potential. The prioritization approach was developed based on the assumption that areas with high erosion rates and strong sediment connectivity represent major sediment sources with a greater likelihood of contributing sediment to downstream river systems. The spatial layers of soil erosion, Index of Connectivity (IC), and Sediment Delivery Ratio (SDR) were classified and overlaid to determine priority conservation zones within the Paguyaman Watershed. The classification scheme consisted of four priority levels: **very high priority**, representing areas with high erosion and high sediment connectivity; **high priority**, representing areas with high erosion and high sediment delivery efficiency; **moderate priority**, representing areas where one of the sediment-related indicators showed elevated values; and **low priority**, representing areas with low erosion intensity and weak sediment connectivity.

The resulting conservation priority map was used to identify potential locations for targeted soil and water conservation measures, including erosion control practices, land rehabilitation, and sediment management strategies. This spatial prioritization approach enables watershed managers to focus limited resources on areas that contribute most significantly to sediment generation and transport processes. By integrating erosion susceptibility and sediment connectivity characteristics, the analysis provides a process-based framework for supporting sustainable watershed management and conservation planning.

Table 1. Classification criteria for conservation priority zones

Conservation Priority	Classification Criteria
Very high priority	High erosion intensity + High sediment connectivity (IC)
High priority	High erosion intensity + High sediment delivery ratio (SDR)
Moderate priority	One sediment-related indicator shows a high value

Low priority	Low erosion intensity + Low sediment connectivity
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Spatial Analysis and Model Implementation

All raster calculations, spatial overlays, and map generation were conducted using ArcGIS Pro, while Python scripts were developed to automate raster processing, parameter calculation, and statistical summarization. The workflow integrated DEM processing, RUSLE factor calculation, IC modelling, SDR estimation, and sediment yield mapping into a reproducible geospatial framework. The use of automated processing improves computational efficiency and ensures consistency in applying the proposed methodology to other tropical watersheds with similar environmental characteristics.

H. TARGET LUARAN DAN ARAH PEMANFAATAN

Pilih hanya luaran yang realistis. Tidak semua penelitian wajib menghasilkan paten atau prototipe.

Jenis Luaran	Target	Status yang Ditargetkan	Keterangan
Publikasi ilmiah	☒	☐ Draft ☒ Submitted ☐ Accepted/Published	Journal of the Civil Engineering Forum (JCEF) (SINTA 1) https://journal.ugm.ac.id/v3/JCEF
HKI/Hak Cipta	☐	☐ Draft ☐ Diajukan ☐ Terdaftar/Granted	.....
Paten/Paten Sederhana	☐	☐ Potensi ☐ Diajukan ☐ Granted	.....
Model/Metode/Formula/Desain	☐	☐ Awal ☐ Tervalidasi	.....
Prototipe/Aplikasi/Produk/Teknologi	☐	☐ Awal ☐ Uji/Validasi ☐ Siap dimanfaatkan	.....
Dataset/Peta/Baseline	☐	☐ Tersusun ☐ Tervalidasi	.....
Rekomendasi/Policy Brief	☐	☐ Draft ☐ Disampaikan ke pengguna	.....
Luaran lainnya	☐		

Calon pengguna/penerima manfaat hasil penelitian (jika ada):

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Potensi tindak lanjut hasil: ☒ Penelitian lanjutan ☐ PkM/KKP ☐ Mitra pengguna ☐ Hilirisasi ☐ Pembelajaran ☐ Lainnya:

I. KOLABORASI DAN KETERLIBATAN

Lintas program studi/disiplin (jika ada)	Lintas program studi Magister Kesehatan Masyarakat dan Program Studi Arsitektur
Mitra penelitian/pengguna (jika ada)	.....
Peran mahasiswa	.....

Potensi integrasi ke pembelajaran	.....
Potensi penerapan melalui PkM/KKP	.....

J. JADWAL PELAKSANAAN

No.	Kegiatan	Bln 1	Bln 2	Bln 3	Bln 4	Bln 5	Bln 6
1	Persiapan	V					
2	Pengumpulan/Pelaksanaan		V				
3	Analisis/Validasi			V	V		
4	Penyusunan Luaran			V	V	V	
5	Pelaporan						V

Jumlah bulan dapat disesuaikan dengan periode hibah.

K. RENCANA ANGGARAN

No.	Komponen	Jumlah (Rp)
1	Bahan/keperluan penelitian	2.000.000
2	Pengumpulan data/pelaksanaan penelitian	3.000.000
3	Transportasi/perjalanan	2.500.000
4	Pengolahan/analisis data dan penunjang	2.500.000
5	Luaran/publikasi/HKI	2.500.000
	TOTAL	Rp 12.500.000

L. DAFTAR PUSTAKA

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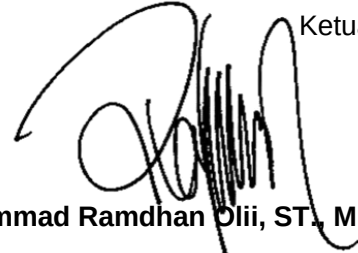
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M. PERNYATAAN KETUA TIM

Saya menyatakan bahwa proposal ini disusun sesuai dengan ketentuan Hibah Penelitian Internal dan bersedia melaksanakan penelitian serta memenuhi target luaran yang ditetapkan.

Limboto, 20 September 2026

Ketua Tim,



(Dr. Ir. Muhammad Ramdhan Olli, ST, M.Eng.)

NIDN. 0924058701

LAMPIRAN INTERNAL LP3M – PETA CEPAT PENILAIAN KESESUAIAN RENSTRA

Bagian ini dapat digunakan reviewer/LP3M. Dosen tidak perlu membuat dokumen tambahan.

Aspek	Yang Dicek	Skor	Catatan Reviewer
Kesesuaian bidang/tema	Proposal dapat dipetakan ke bidang, tema/subtema atau pengembangan disiplin yang relevan	0–20	
Kesinambungan roadmap	Posisi penelitian dan arah lanjutannya jelas	0–20	
Relevansi masalah	Relevan dengan kepakaran, potensi/kebutuhan daerah, pembangunan atau SDGs sesuai karakter penelitian	0–15	
Metode & kelayakan	Metode, waktu dan anggaran layak	0–20	
Luaran bertahap	Luaran sesuai tahap roadmap: publikasi/dataset/model/HKI/prototipe/validasi/pemanfaatan	0–15	
Kolaborasi & pemanfaatan	Ada peluang kolaborasi, mahasiswa, mitra, pembelajaran, PkM/KKP atau pemanfaatan hasil bila relevan	0–10	

TOTAL: / 100

Rekomendasi: ☐ Layak didanai ☐ Layak dengan perbaikan ☐ Belum layak

Catatan: Penelitian tidak harus menghasilkan seluruh jenis luaran. Penilaian mempertimbangkan kesesuaian luaran dengan tahap roadmap dan karakter penelitian.