SIMULASI *RUNOUT* LONGSOR MENGGUNAKAN MODEL *GRAVITATIONAL PROCESS PATH* (GPP) DI RUAS JALAN SALAMAN-BENER KABUPATEN MAGELANG

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Intisari

Deskripsi lintasan longsor dan jarak *run-out* merupakan bagian fundamental dari zonasi kerawanan dalam penentuan elemen yang berisiko *(element at risk)*. Ruas Jalan Salaman-Bener Kabupaten Magelang merupakan zona rawan aktivitas longsor yang cukup intensif setiap tahunnya. Kejadian longsor pada tanggal 18 Januari 2019 di desa Krasak, Kecamatan Salaman yang berada pada ruas jalan Salaman-Bener memiliki tipologi *complex* yang terdiri dari *translational slide* disertai dengan *flow*. Tingkat probabilitas kejadian longsor tergolong tinggi terutama pada musim penghujan sehingga tipe longsor yang sangat mungkin terjadi adalah tipe *debris flow*. Pemodelan kerawanan lonngsor dilakukan untuk mengetahui (i) mengidentifikasi area longsor dan sumber longsor *(source area,* (ii) mengetahui jarak jangkauan longsor *(run-out distance),* (iii) memprediksi kecepatan material longsoran, (iv) mengetahui ketebalan material deposisi.

Penilaian kerawanan longsor secara regional di ruas jalan Salaman-Bener melalui pendekatan Model *Gravitational Process Path* (GPP) dapat mensimulasikan gerakan massa *(debris flow)* di atas DEM LiDAR. Model GPP mengintegrasikan beberapa model yang menjadi dasar dalam membangun konsep pemodelan. Penentuan lintasan longsor menggunakan model *random walk*, penentuan *run-out* menggunakan *Two-Parameter Friction Model* (PCM), dan penentuan deposisi menggunakan pendekatan *slope and/or velocity dan sink filling*. Data yang digunakan untuk membangun model meliputi data *Digital Terrain Model* (DTM) LiDAR, area sumber longsor, parameter *friction* (μ), dan ketebalan material. Area sumber longsor yang telah diverifikasi sebanyak 77 dan ketebalan material berada pada rentang 0,28- 4,6 meter.

Parameter yang diterapkan dalam model berdasarkan data kalibrasi metode *trial and error* dengan tingkat kepercayaan >80%. Data kalibrasi menggunakan *debris flow* yang pernah terjadi sekitar lokasi penelitian dengan asumsi memiliki karakteristik geomorfologi yang sama. Hasil model yang diperoleh meliputi; (a) panjang *run-out* pada rentang 25,74-262, 57 meter; (b) kecepatan makasimum pada rentang 0-13,8 m/s; (c) sebaran ketebalan material deposisi pada rentang 0-10,34 meter. Luaran *(output)* model GPP dapat digunakan sebagai dasar analisis risiko longsor seperti jalan, permukiman, dan area terdampak lainnya pada skala detail di ruas Jalan Salaman-Bener.

Kata kunci: LiDAR, *Gravitational Process Path* (GPP), *debris flow*, *run-out* longsor

LANDSLIDE RUNOUT SIMULATION USING THE GRAVITATIONAL PROCESS PATH (GPP) MODEL IN THE SALAMAN-BENER ROAD SECTION OF MAGELANG REGENCY

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Abstract

The description of landslide trajectories and run-out distances forms a fundamental part of hazard zoning aimed at determining the elements at risk. The Salaman-Bener Road section in Magelang Regency is a zone prone to landslide activity, and this activity is quite intensive on an annual basis. An example of this is the landslide incident that occurred on January 18, 2019, in Krasak village, Salaman District, which is along the Salaman-Bener road. The incident involved a complex typology of translational slides accompanied by a flow. The probability of landslides is relatively high, especially during the rainy season, making the debris flow type the most likely to occur. Landslide susceptibility modeling is conducted to (i) identify the landslide area and source area, (ii) determine the run-out distance, (iii) predict the speed of the landslide material, and (iv) ascertain the thickness of the deposition material.

The regional landslide susceptibility assessment along the Salaman-Bener road section, utilizing the Gravitational Process Path (GPP) Model approach, can simulate mass movement (debris flow) above the LiDAR DEM. The GPP model integrates several foundational models, forming the basis for the construction of modeling concepts. Determination of the landslide trajectory employs a random walk model, run-out determination is done using the Two-Parameter Friction Model (PCM), and deposition determination utilizes slope and/or velocity in conjunction with the sink filling approach. The data utilized for model development includes Digital Terrain Model (DTM) LiDAR data, landslide source area data, friction parameters (μ), and material thickness. The study identifies 77 verified landslide source areas, and the material thickness falls within the range of 0.28-4.6 meters.

The parameters utilized in the model were based on the calibration data using a trial and error method with a confidence level exceeding 80%. The calibration data is derived from debris flows that have previously occurred in the vicinity of the research location, assuming that they possess similar geomorphological characteristics. The resultant model outputs encompass: (a) run-out length falling within the range of 25.74-262.57 meters; (b) maximum speed ranging from 0 to 13.8 m/s; (c) distribution of material deposition thickness ranging from 0 to 10.34 meters. The outcomes of the GPP model can serve as a foundational basis for landslide risk analysis encompassing factors such as roads, settlements, and other impacted areas at a detailed scale along the Salaman-Bener Road section.

Key words: LiDAR, Gravitational Process Path (GPP), debris flow, landslide run-out