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# Indonesia Disaster Knowledge Update - November 2023



## Disaster-related Research Publication about Landslide in Indonesia

### Introduction

In the November 2023 edition of IDKU, CARI! conducted a systematic literature review on Landslide Studies in Indonesia, employing the Landslide Guidebook by the USGS. The research publications were organized into three categories: **triggering factors**, **landslide assessments**, and **study area coverage**. In terms of triggers, rain-induced and seismic factors were identified as primary contributors to landslides in Indonesia.

Moving to the crucial aspect of landslide assessment, the review categorized these methodologies into five subcategories. The first, **Inventory assessment**, involved the meticulous collection of landslide event data to create a comprehensive database. **Susceptibility assessment**, the second subcategory, delineated landslide-prone areas by correlating factors like steep slopes and weak geological units. **Hazard assessment**, the third subcategory, revealed spatial threats and the probability of future occurrences. **Vulnerability assessment**, the fourth subcategory, evaluated the susceptibility of specific areas to landslide impacts. Finally, **Risk assessment**, the fifth subcategory, offered a comprehensive analysis of potential consequences on both human and environmental aspects, integrating factors such as topography and climate patterns. These assessments collectively provided a nuanced understanding of landslide dynamics in Indonesia.

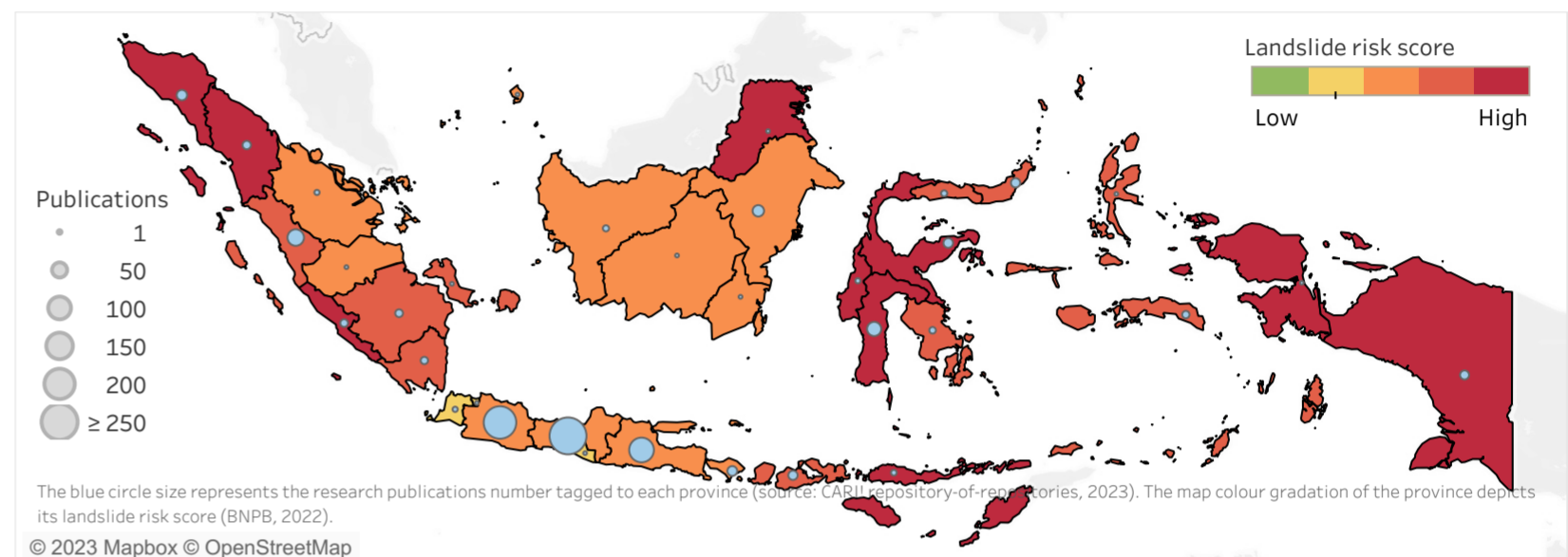
The Landslide Guidebook further divides the scale of assessments into three categories: **Regional mapping**, **Community-level mapping**, and **Site-specific mapping**. **Regional mapping** provides basic data for regional planning, serving as a foundation for more detailed community and site-specific studies. These maps typically range in scale from 1:10,000 down to 1:4,000,000. **Community-level mapping** offers detailed data at the village level, with scales ranging from 1:1,000 to 1:10,000, aiding in land use and building decisions. **Site-specific mapping**, on the other hand, focuses on identifying, analyzing, and solving specific problems through detailed drilling programs and laboratory analysis, often at a scale of 1:600.

Reference: USGS. (2008). [The Landslide Handbook - A Guide to Understanding Landslides](#)



### The number of studies are concentrated in Java regions

#### Research article distribution map

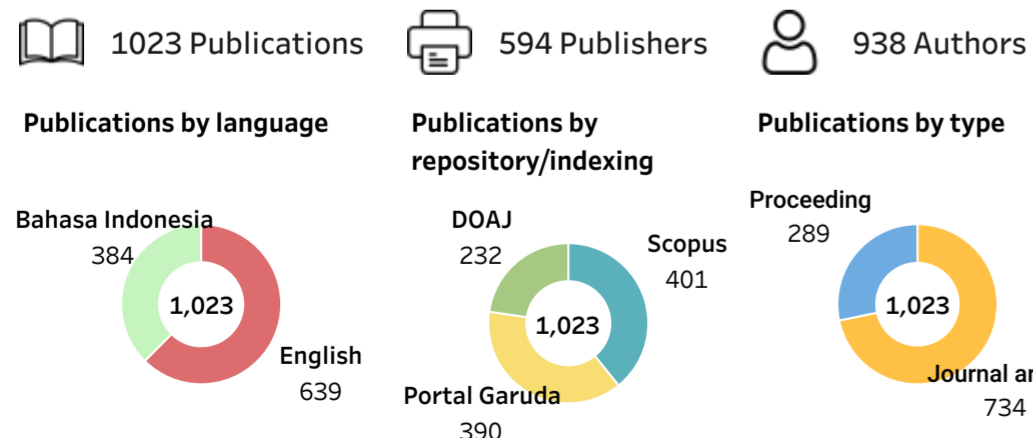


#### Volume of publication by municipality/regency



This map reveals a significant disparity in the number of publications between the Java region and areas outside Java. Particularly noteworthy are the provinces of Central Java and West Java, which boast a substantial number of studies compared to other regions, comprising 262 and 194 publications, respectively. The dense population and the presence of numerous hilly terrains in the Java region contribute to a high incidence of landslides. Consequently, several educational institutions, predominantly situated in Java, have conducted extensive research on this issue. The word cloud indicates that numerous municipalities/regencies have emerged as research focal points regarding landslides. The pattern reveals that a higher number of publications were identified in municipalities/regencies that have experienced landslides and possess hilly terrain, such as Semarang, Banjarnegara, and Bandung. Overall, there are 215 administrative areas designated as study locations for landslide assessments.

## Research Articles Statistics



For analytical purposes, we examined research articles related to landslide. The scientific articles were obtained from CARI! Knowledge Engine sourced from Scopus, DOAJ, and Portal Garuda repositories. All journal articles and proceedings were included in this analysis. Also, only articles written in English and Bahasa Indonesia were included. In total, we selected **1023 publications** from 594 publishers to be reviewed in the subsequent analysis.

### Internal and rain are the most studied factors

#### Distribution of publication by triggering factors



The graph shows the distribution of research based on the triggering factors. There are 439 publications that delve into landslide studies, focusing on internal factors (i.e. slope, land use, rocks, distance to road, and others) without mentioning the external triggers. Regarding external triggering factors, 394 publications explicitly cite rainfall as a catalyst for landslides. This is understandable, considering that the majority of landslides in Indonesia are primarily influenced by hydrometeorological factors rather than seismic ones. Consequently, only 123 publications mention seismic external factors as landslide triggers, with an additional 67 publications acknowledging both external factors.

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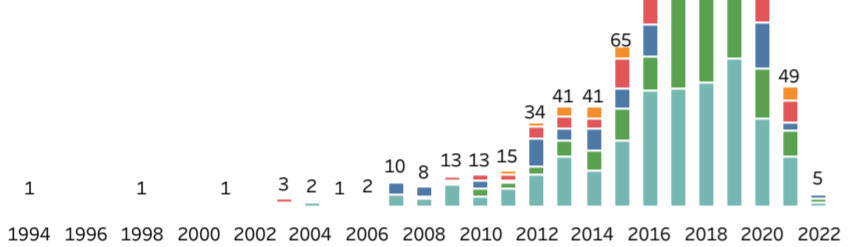


## Research Growth & Descriptive Analysis

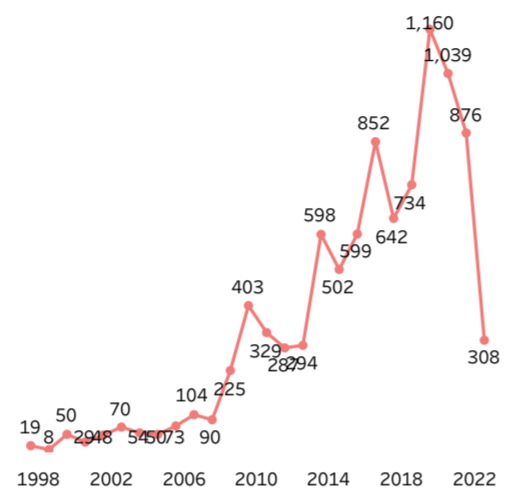
The growth of landslide research shows a positive trend, particularly susceptibility assessment topic

Research publications trend by year

Category	Publications
Inventory	129 publications
Risk	147 publications
Hazard	167 publications
Vulnerability	209 publications
Susceptibility	371 publications



Landslide disaster trend by year



The growth of disaster research in landslide assessments continues to escalate, with a noticeable surge in publications observed after 2015. This can be attributed to the increasing trend of landslide disasters occurring each year. Examining the trend patterns depicted in the two graphs above, it becomes evident that the rising number of landslide events has spurred a considerable amount of research in landslide assessments. Furthermore, a significant number of studies, totaling 371 publications, focus on the topic of susceptibility, while vulnerability is addressed in 209 publications. This emphasis on susceptibility and vulnerability assessment is crucial as it represents the initial phase before conducting hazard and risk assessments. Regrettably, the topic of landslide inventory lags behind with the lowest number of publications.

Landslide assessment studies are becoming increasingly detailed

Proportion of publications by study coverage area

[Less detail -> more detail](#)

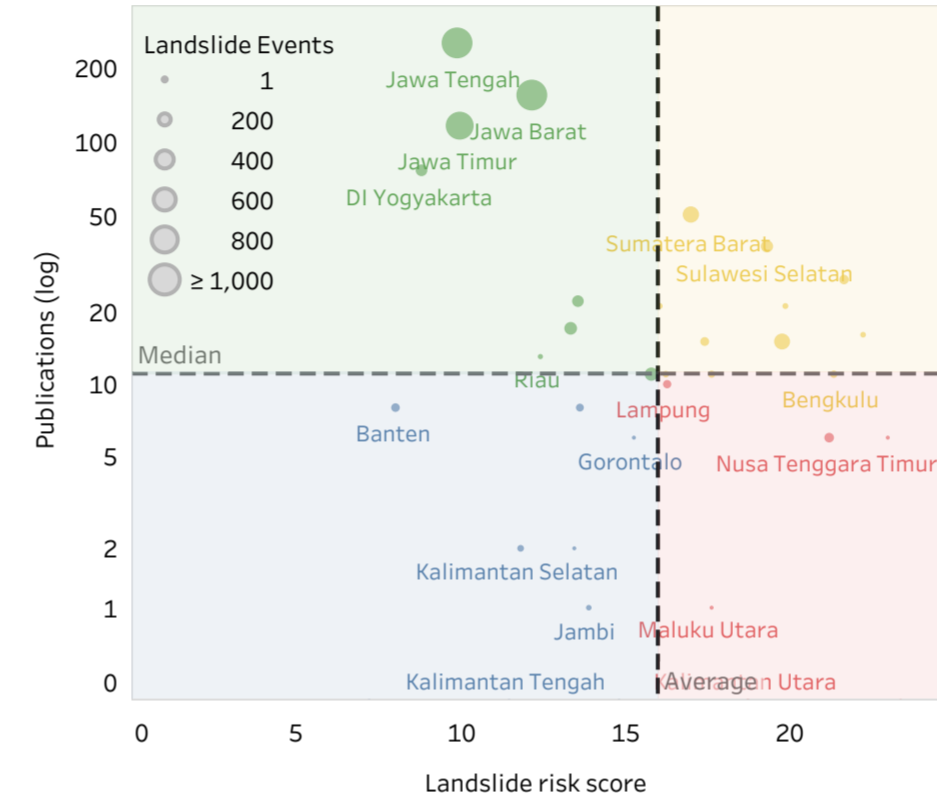


Regional, province, city/regency, & sub-regency levels | Village, community, & local hilly area levels | Slope, road, & other site-specific levels

The graph illustrates the distribution of landslide assessment studies categorized by the scale of study coverage. Notably, landslide assessments at the regional scale level have been the most extensively studied, totaling 408 publications, encompassing coverage from regional to sub-regency levels. However, an intriguing revelation emerges as more detailed landslide assessment studies are identified, with a total of 404 publications at the community level, covering villages, communities, and local hilly areas, and 211 publications at the site-specific level, encompassing specific slopes, roads, and other specific sites. This indicates a robust knowledge base spanning regional, community, and site-specific levels, suggesting a relatively minimal knowledge gap.

Numerous studies are located in regions experiencing a higher frequency of landslide events, irrespective of their risk level

Quadrant plot of number of publications vs landslide risk score



Category  
 Less publications, higher risk (Red)  
 Less publications, lower risk (Blue)  
 More publications, higher risk (Yellow)  
 More publications, lower risk (Green)

We divided the provinces into four groups based on the average number of publications and the landslide risk score. The cutoff risk score for the high-risk category is set at  $\geq 16$ , delineating the quadrant plot. The plot exhibits four categories: more publications & higher risk (yellow), more publications & lower risk (green), fewer publications & higher risk (red), and fewer publications & lower risk (blue). Additionally, we incorporated landslide disaster event data based on administrative areas, represented by the circle size.

Administrative areas with higher disaster events have prompted more research publications on those regions. Eight regions fall into the green category: Central Java, East Java, West Java, East Kalimantan, Bali, Riau, South Sumatera, and the Special Region of Yogyakarta. Nine regions are classified as yellow, namely West Sumatera, South Sulawesi, Aceh, Central Sulawesi, Papua, West Nusa Tenggara, and North Sulawesi. This indicates that regions with a high incidence of landslide disasters already possess an above-average knowledge base. However, many regions still fall into the red category, signifying a lack of knowledge base for landslide assessments in these areas, despite the relatively smaller number of disasters compared to the yellow and green categories.

## Top Research Article

Top 3 publications based on citation count

**Earthquake induced landslide susceptibility mapping using an integrated ensemble frequency ratio and logistic regression models in West Sumatera Province, Indonesia**  
 Umar Z. | Catena  
 published on January 1, 2014 | cited by 156 articles

**Performance of frequency ratio and logistic regression model in creating GIS based landslides susceptibility map at Lompobattang Mountain, Indonesia**  
 Rasyid A.R. | Geoenvironmental Disasters  
 published on December 1, 2016 | cited by 114 articles

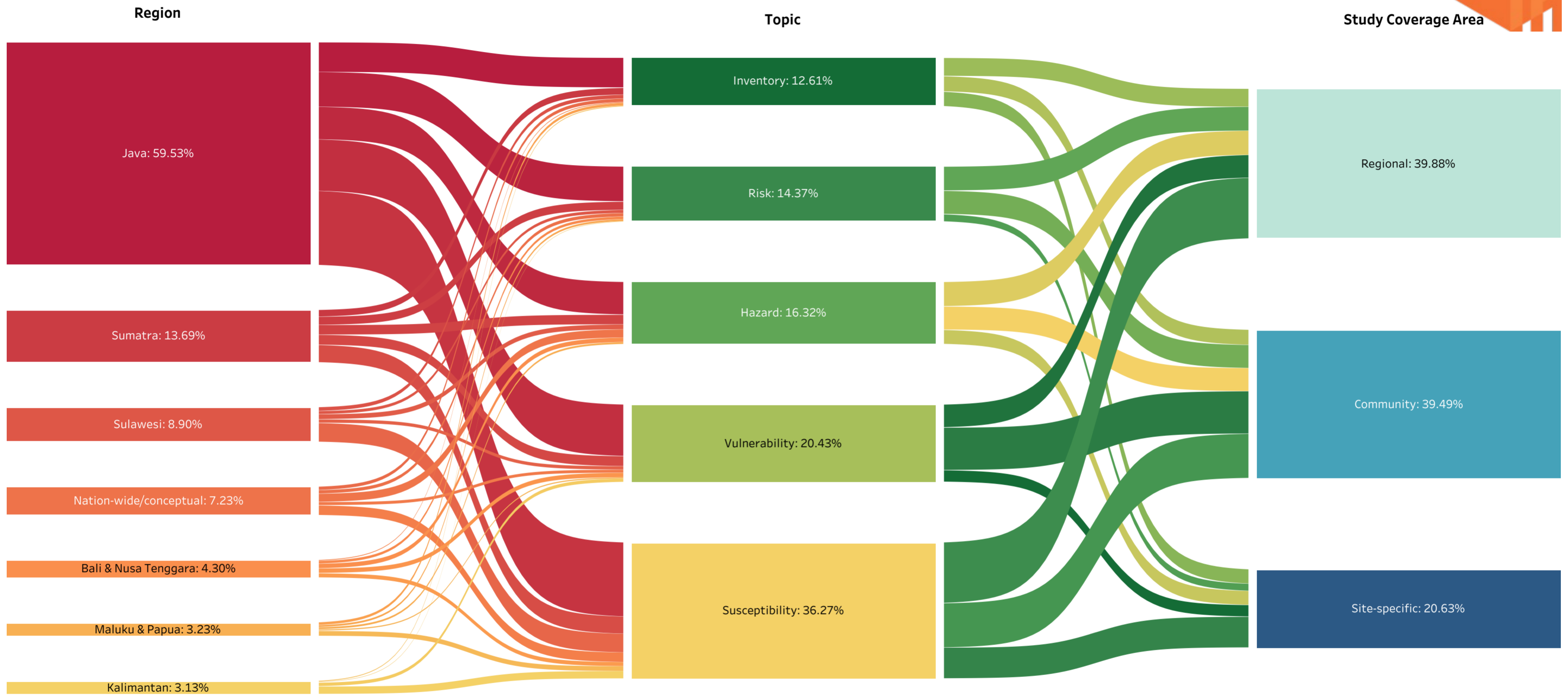
**Prototyping an experimental early warning system for rainfall-induced landslides in Indonesia using satellite remote sensing and geospatial datasets**  
 Liao Z. | Landslides  
 published on May 31, 2010 | cited by 76 articles

The list above represents the top three publications on landslide assessments, ranked by citation numbers recorded by Scopus as of November 2023. Each of the three studies addresses distinct topics. The first publication delves into the subject of earthquake-induced landslide susceptibility mapping using a statistical approach. The second publication focuses on assessing the performance of the statistical approach in mapping landslide susceptibility. The third publication explores the readiness of the flood early warning system for rainfall-induced landslides in Indonesia, employing satellite remote sensing and geospatial datasets.

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## Sankey Diagram of Publications: Research Location to Landslide Topic to Study Coverage Area



The Sankey diagram visually represents the number of publications in proportion. Larger box sizes and wider lines correspond to a greater number of publications. The diagram illustrates the distribution of research articles and their relationships across studied locations, landslide assessment topics, and study coverage areas.

The Sankey diagram is employed to elucidate the co-analysis relationship among research locations, landslide assessments, and study coverage areas investigated in each research article. Of all research conducted, 59.53% or 609 articles are focused on the Java region, followed by the Sumatra region with 13.69% or 140 articles, and the Sulawesi region with 8.90% or 91 articles. The distribution of research locations correlates with the prevalence of landslides in Java, coupled with higher population density, particularly in hilly areas. The concentration of institutions in Java Island could contribute to the research distribution gap. Additionally, a substantial number of studies, totaling 36.27% of total publications, concentrate on the topic of susceptibility, while vulnerability is addressed in 20.43% of total publications. This emphasis on susceptibility and vulnerability assessment is crucial as it represents the initial phase before conducting hazard and risk assessments. Hazard and risk assessments contribute to 16.32% and 14.37% of total publications, respectively. Unfortunately, the topic of landslide inventory lags behind with the lowest number of publications.

Most of the landslide assessment topics were discussed at the regional and community levels, contributing 39.88% and 39.49% to the total publications, respectively. Meanwhile, publications addressing the site-specific level accounted for 20.63% of the total publications. This indicates a robust knowledge base that spans regional, community, and site-specific levels, suggesting a relatively minimal knowledge gap. The substantial number of publications at the regional and community levels can be attributed to the availability of publicly accessible data at these broader scales. Additionally, the less detailed method of assessing landslides at the regional and community levels, compared to the more specific site-specific level, is one of the reasons for the prevalence of studies at a broader scale.