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# Geomorphological Characteristics of the East Bandung Basin, West Java, Indonesia

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***Abstract*****—** *The eastern part of the Bandung Basin exhibits diverse geomorphological characteristics resulting from variations in relief, slope, drainage pattern, geological conditions, and geomorphic processes. This study aims to characterize the geomorphology of the East Bandung Basin based on three complementary aspects, namely morphometry, morphography, and morphogenesis. The analysis integrates topographic data, a Digital Elevation Model (DEM), geological maps, and Geographic Information Systems (GIS).. Morphometric analysis focuses on elevation, relief, and slope characteristics, while morphographic analysis examines surface relief, valley configuration, and drainage patterns. Morphogenetic interpretation integrates the morphometric and morphographic characteristics with geological conditions. The results indicate that the study area has slope gradients ranging from flat to very steep, ranging from 0–8% to >40%, with relatively gentle terrain mainly distributed in the central to western parts and steeper terrain predominantly occurring in the northern, eastern, and southern parts. Six drainage patterns were identified, namely radial, subradial, parallel, subparallel, subdendritic, and anastomotic. The geomorphology of the study area is mainly influenced by volcanic and fluvial processes, with weathering and erosion contributing to subsequent surface modification. The morphogenetic interpretation is consistent with the geological, morphometric, and morphographic characteristics of the study area, providing an integrated understanding of its geomorphological development.*

***Keywords*****—** *Geomorphology, Morphometry, Morphography, Morphogenesis, Bandung Basin.*

## I. INTRODUCTION

The Bandung Basin is a significant landscape feature in West Java, characterized by an area of relatively low relief surrounded by hills and mountains [1,2]. The eastern part of the Bandung Basin comprises several subwatersheds that represent different drainage and landscape settings across the study area (Fig. 1). It exhibits diverse geomorphological characteristics, as it lies within a transition zone between the central lowlands and the hilly to mountainous terrain to the north, east, and south. Geologically, the area is composed primarily of Quaternary volcanic rocks in the north, east, and south, while extensive alluvial deposits cover the central section [3]. These conditions result in distinct topographic and landform variations, ranging from steep and very steep slopes to flat or gently sloping plains.

Geomorphological study of the East Bandung Basin is important because landform characteristics not only reflect current topographic conditions but also provide insights into the geomorphic processes shaping the landscape [4–6]. Morphometric analysis allows for the quantitative description of form and relief characteristics, while morphographic analysis provides an overview of landform expression and configuration. These approaches can be complemented by morphogenetic analysis to understand the primary processes involved in landform development.

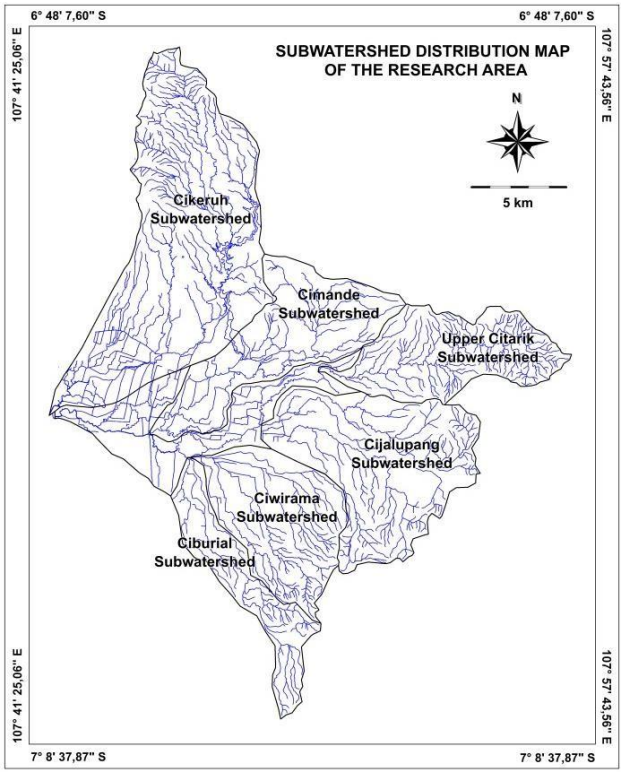


Fig. 1. Location of the study area and distribution of subwatersheds.

Although the Bandung Basin has been extensively studied from various geological and environmental perspectives [7], there remains a need for study that specifically integrates morphometric, morphographic, and morphogenetic analyses to characterize the geomorphology of the East Bandung Basin. Such an approach is essential for developing a more systematic geomorphological overview, particularly in areas exhibiting transitions between hilly terrain, mountainous areas, valleys, and basin plains. Furthermore, this study can serve as a foundation for future study concerning geomorphic processes, regional management, and environmental change.



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Therefore, this study aims to identify and describe the geomorphological characteristics of the East Bandung Basin based on morphometric, morphographic, and morphogenetic aspects. The analysis utilizes topographic data, drainage networks, geological data, and Geographic Information Systems (GIS). The study focuses on surface geomorphological characteristics and their formative processes, without delving deeply into morphotectonic aspects.

## II. METHODOLOGY

This study was conducted through a desktop study using Geographic Information Systems (GIS) [8,9] to integrate topographic data, Digital Elevation Model (DEM), and geological map. The National Digital Elevation Model (DEMNAS) was generated from IFSAR (5 m), TerraSAR-X (5 m), and ALOS PALSAR (11.25 m) datasets, supplemented by mass-point stereo data with a spatial resolution of 0.27 arc-seconds and referenced to the EGM2008 vertical datum [10]. The geomorphological analysis focused on three aspects, namely morphometry, morphography, and morphogenesis. Morphometry was used to quantitatively describe landform characteristics, specifically regarding relief and slope gradient. Morphography was used to identify and describe the shape and configuration of the land surface, including relief, valleys, and drainage patterns. Meanwhile, morphogenesis was used to interpret the dominant processes that shape and modify landforms. These aspects were integrated to characterize the geomorphology of the study area.

Morphometric analysis utilized a DEM to derive information on elevation, relief, and slope gradient. The DEM data were processed using GIS software to generate elevation and slope map, which were then used to identify variations in topographic characteristics across the study area. Slope classification served as a parameter for distinguishing morphometric characteristics between different parts of the area. In addition to slope gradient (Table I), variations in elevation and relief were used to differentiate between lowlands, hilly areas, and zones with higher relief.

TABLE I. Slope Classification, modified from [11].

| No. | Slope (%) | Class |
|---|---|---|
| 1 | 0 – 8 | Flat |
| 2 | 8 – 15 | Very gentle |
| 3 | 15 – 25 | Slightly steep |
| 4 | 25 – 40 | Steep |
| 5 | > 40 | Very steep |

Morphographic analysis involved interpreting surface forms and landscape configurations based on the results of DEM and topographic map analysis. The elements analyzed included relief forms, slope configurations, valley characteristics, and drainage patterns. Stream networks were extracted from topographic data and interpreted based on the spatial arrangement of stream channels relative to relief forms and surface conditions. Drainage patterns (Fig. 2) serve as a key element in distinguishing morphographic characteristics, as the configuration of the stream network reflects variations in surface morphology and geomorphological conditions [12]. The integration of relief, slope gradient, valley characteristics, and drainage patterns was subsequently used to describe the morphographic characteristics of the study area.

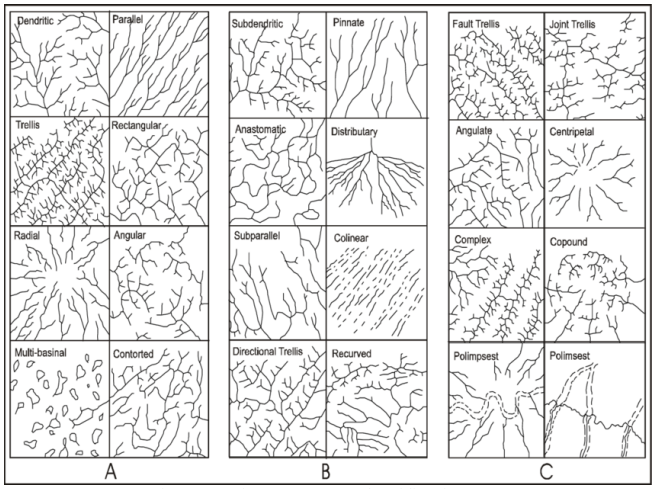

Fig. 2. Drainage pattern classification [13]

Morphogenetic analysis was conducted by integrating the results of morphometric and morphographic analyses with data on lithology and geological conditions from the geological map [3]. The morphogenetic aspect is used to identify the dominant processes driving landform formation and modification, namely volcanic and fluvial processes, with weathering and erosion contributing to subsequent surface modification. Process classification is based on the interrelationships among relief characteristics, landforms, drainage patterns, slope gradients, and constituent materials.

## III. RESULTS AND DISCUSSION

### A. Morphometry of the East Bandung Basin

The morphometry of the East Bandung Basin is characterized by distinct variations in slope gradients, ranging from 0–8% to >40% (Fig. 3). Based on the slope gradient map, the study area can be classified into five categories: 0–8%, 8–15%, 15–25%, 25–40%, and >40%. These variations indicate a clear shift in topographic character between areas of relatively low relief and those with higher relief. Slope gradient classes serve as the morphometric parameter in this study to describe the quantitative surface characteristics and relief distribution of the area.

The 0–8% slope class is the most extensive, particularly in the central to western parts of the study area, encompassing the areas around Cileunyi, Rancaekek, and Majalaya. This zone features a relatively flat to very gentle surface and generally occupies low-relief areas. Near Jatinangor and parts of Cicalengka, slope gradients begin to show greater variation, with the emergence of the 8–15% and 15–25% classes. This shift indicates a morphometric transition from flat terrain to areas with increasingly steep relief.

Slope gradients of 25–40% and >40% are primarily found in the northern, eastern, and southern parts of the study area. Zones with very steep slopes (>40%) are prominent around Tanjungsari, Cimanggung, the southeastern part of Cicalengka, and the south of Cikancung and Paseh. This spatial pattern



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reveals that the steepest relief occurs mainly along the margins of the study area, whereas low-slope areas are more extensive in the center of the basin. Thus, the distribution of slope gradients reflects a topographic trend shifting from relatively flat surfaces in the center toward steeper relief in the surrounding higher elevations. Overall, the slope distribution indicates that the eastern part of the Bandung Basin possesses heterogeneous morphometric characteristics, with a distinct contrast between the flatlands and the hilly to mountainous terrain. Areas with slopes of 0–8% form a relatively extensive zone in the central-western section, whereas the 15–25%, 25–40%, and >40% slope classes become increasingly prevalent in areas of higher relief. These slope variations serve as a basis for understanding changes in the study area's morphographic characteristics, particularly regarding relief forms, valley configurations, and drainage patterns.

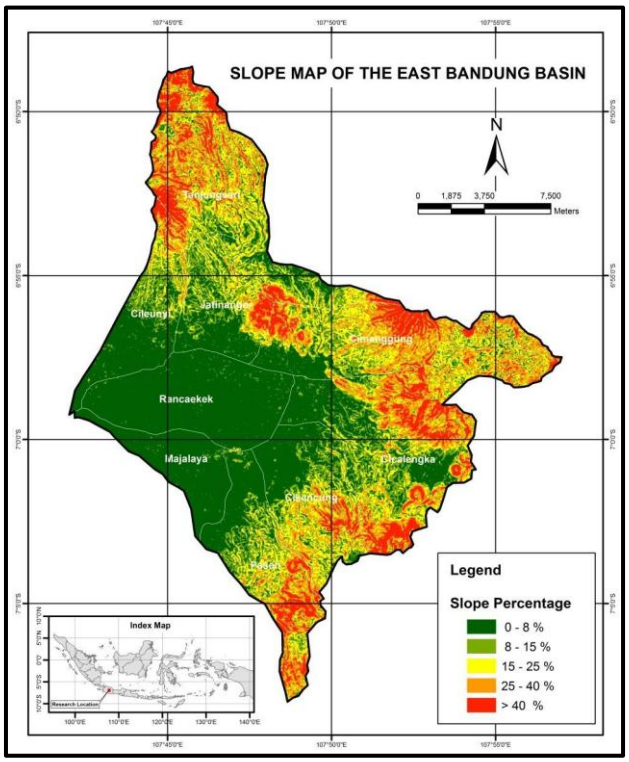


Fig. 3. Slope map of the East Bandung Basin.

## B. *Morphography of the East Bandung Basin Area*

The morphography of the East Bandung Basin exhibits a diversity of surface forms associated with variations in relief and topographic configuration. In general, the study area consists of hill and mountain slopes with gradients ranging from flat to very steep. The western part of the study area is dominated by relatively low relief with flat to gentle slopes such as Jatinangor, Cileunyi, Rancaekek, Cicalengka, and Majalaya. On the other hand, the northern, eastern, and southern parts exhibit higher relief characterized by steep to very steep slopes.

These morphographic characteristics are reflected in the configuration of the drainage pattern developed within the study area. Based on the interpretation of the drainage pattern, six drainage patterns were identified, namely radial, subradial, parallel, subparallel, subdendritic, and anastomotic. These patterns indicate variations in surface and geomorphological conditions across different parts of the study area. Radial and subradial patterns have developed in areas featuring volcanic cone morphologies, with flow directions radiating outward from a central point toward lower elevations. In the radial pattern, channel development is relatively complete across multiple slope faces, whereas the subradial pattern exhibits more limited channel development.

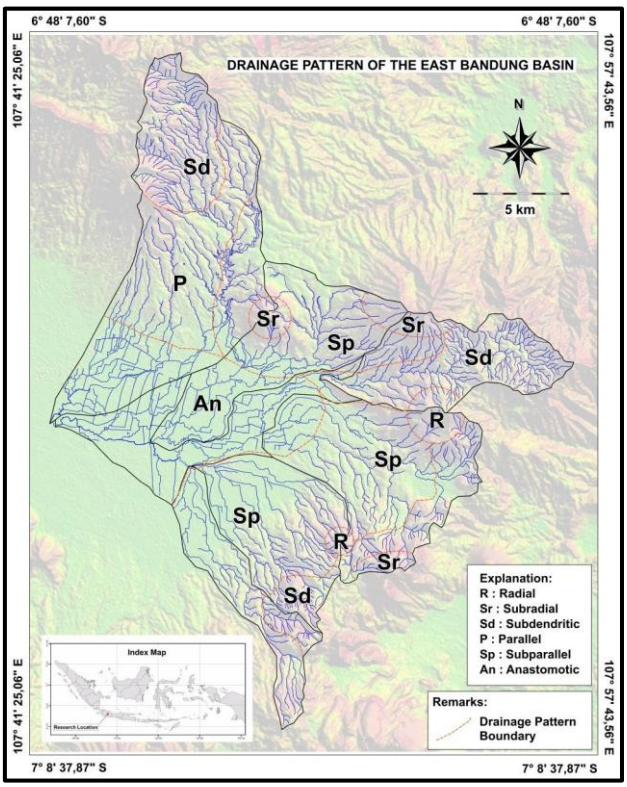


Fig. 4. Drainage pattern of the East Bandung Basin.

Parallel and subparallel patterns have developed across nearly all subwatersheds, particularly on the main bodies of hill or mountain slopes and in headwater areas. The parallel pattern is characterized by channels arranged relatively parallel to one another and is commonly found in elongated hill morphologies with moderately steep to very steep slopes. Meanwhile, the subparallel pattern features a channel arrangement resembling the parallel pattern but lacks the same degree of regularity. Previous studies in this area have linked the development of subparallel patterns to variations in slope gradient and changes in relief form, including transitions between hill or mountain cone morphologies and general hill or mountain slopes. A subdendritic pattern is observed in several slope areas, occurring in both the upstream and downstream sections of the subwatershed. This pattern features a configuration resembling tree branching and develops in areas with slopes ranging from relatively gentle to moderately steep. In contrast, an anastomotic pattern develops primarily in the central to western parts of the study area. This pattern exhibits interconnected channels and forms on flat terrain or in areas with very low



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gradients. Its presence is associated with alluvial deposits and floodplain, particularly around Rancaekek and Majalaya, as well as parts of Jatinangor and Cicalengka.

Morphographically, this diversity reflects a transition in landscape character, namely high relief areas and steep slopes in the north, east, and south to low relief and gentler slopes in the central and western part. This transition is reflected by the variation of drainage patterns (Fig. 4) ranging from radial and subradial patterns on volcanic cones, parallel and subparallel patterns on hill and mountain slopes, and subdendritic patterns in areas of more uniform relief, to anastomotic patterns in flat areas. Thus, drainage patterns serve as a key characteristic in describing the morphographic variation of the East Bandung Basin.

### *C. Morphogenesis of the East Bandung Basin Area*

The morphogenesis of the East Bandung Basin is primarily shaped by volcanic and fluvial processes, modified by weathering and erosion. The northern, eastern, and southern parts of the study area are dominated by Quaternary volcanic rocks, whereas the central part consists mainly of Quaternary alluvial deposits. These conditions influence the development of the relief and surface morphology.

Volcanic processes are primarily reflected in areas characterized by high relief and morphologies featuring volcanic cones and slopes. The presence of radial and subradial drainage patterns in certain parts of the area reinforces this volcanic character. These patterns develop on volcanic cone morphologies, indicating flow radiating from higher elevations toward lower-lying areas.

Fluvial processes manifest primarily through valley formation, the development of river networks, and the transport and deposition of material. Alluvial environments with anastomosing drainage patterns develop in areas of lower relief and relatively gentle slopes. Meanwhile, parallel, subparallel, and subdendritic patterns occur in hilly areas and on slopes characterized by more varied relief.

Overall, the morphogenetic interpretation aligns with the geological (Fig. 5), morphometric, and morphographic characteristics of the study area. Areas underlain by volcanic rocks and exhibiting higher relief generally display hilly to mountainous morphographic characteristics, whereas areas with lower relief and alluvial deposits exhibit the characteristics of plains with gentler slopes. Thus, these three aspects mutually support the explanation of the geomorphological development of the East Bandung Basin.

## IV. CONCLUSION

The eastern part of the Bandung Basin exhibits varied geomorphological characteristics, evidenced by variations in relief and slope gradients ranging from flat to very steep. Areas with relatively low gradients are primarily found in the central to western part, whereas steeper to very steep slopes predominate in the northern, eastern, and southern parts.

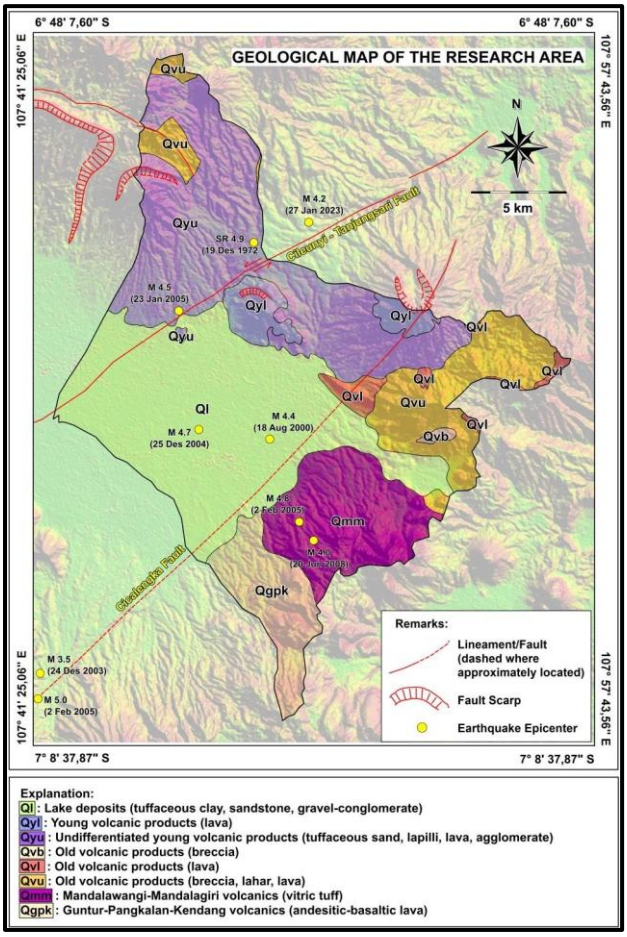


Fig. 5. Geological map of the East Bandung Basin, modified from [14]

Morphographic characteristics are reflected in the varied relief forms and drainage patterns, which include radial, subradial, parallel, subparallel, subdendritic, and anastomotic types. This diversity of patterns indicates a transition in landscape character from areas of high relief and volcanic slopes to areas with lower relief and plain environments.

From a morphogenetic perspective, the landscape of the East Bandung Basin is primarily shaped by volcanic and fluvial processes, with weathering and erosion playing roles in surface modification. This morphogenetic interpretation aligns with the distribution of volcanic rocks and alluvial deposits shown on the geological map, as well as with the morphometric and morphographic characteristics of the study area. Integrating these aspects provides an overview of the geomorphological character of the East Bandung Basin.

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