Action Research Literate
Vol. 9, No. 12, December 2025
ISSN: 2808-6988

Land Contour Analysis for the Planning of Al-Amin Living Lab and Industrial Park in Sampe Cita Village, Kutalimbaru District

Fariz Harindra Syam* , Dara Wisdianti, Syahna Dwi Ardianti
Universitas Pembangunan Panca Budi, Indonesia
Email: farizharindrasyam@dosen.pancabudi.ac.id*

Keywords:
Land contours; Topography; Elevation mapping; Drone mapping; GPS RTK.

Abstract

Land contour measurement is a fundamental step in planning and designing areas, especially integrated areas based on education, innovation, and eco-educational tourism. This study aims to determine the topography of the Al-Amin Living Lab and Glugur Rimbun Industrial Park in Sampe Cita Village, Kutalimbaru District, as a base map for area design. The study used a descriptive-quantitative approach with geodetic GPS-based contour measurement techniques and a 20-meter grid method. The elevation data obtained were processed using Global Mapper software to produce a topographic map with a contour interval of 0.5 meters. The results show that around 60% (approximately 12 hectares) of the total land has relatively flat contours, especially in the west and south, while the other 40% (approximately 8 hectares) has steep and ravine-like contours, predominantly in the east and north near the river. Land slope analysis confirmed these topographical variations and provided an important basis for determining zoning, building placement, circulation routes, and land engineering strategies in the area design. This study produced the precision topographic maps needed for the master plan of the Al-Amin Living Lab and Industrial Park and supported the development of an area oriented toward sustainability and the integration of educational, economic, and environmental functions.

INTRODUCTION

The Kutalimbaru District is one of the regions in Deli Serdang Regency characterized by diverse landforms, ranging from flat terrain to areas with steep slopes (Richi, 2025).. This topographical variation makes the area particularly sensitive to spatial planning changes, especially when intended for development as an educational, tourism, or industrial zone (Waghs & Sharad, 2025). Universitas Pembangunan Panca Budi has designated Sampe Cita Village as the development site for the Al-Amin Living Lab and the Glugur Rimbun Industrial Park, an integrated area designed to support education, research, field laboratories, innovation, and agriculture- and environment-based eco-edu-tourism (Bookhart, 2025). The area is planned to function as a multidisciplinary learning environment, a center for sustainable technological innovation, and a public educational destination that integrates economic, social, and ecological values (Herth et al., 2025).

Large-scale area planning, such as that of a Living Lab and Industrial Park, requires a detailed understanding of the site's physical conditions—particularly contour and topographical slope—as the basis for determining zoning, building placement, circulation systems, and site engineering (Thapa et al., 2025). Without precise contour maps, the design process may become inaccurate and inefficient, potentially leading to technical issues such as improper building placement, inadequate drainage systems, and increased land-engineering costs (National Research Council, 2010). Therefore, contour measurement is a

crucial initial step in preparing the master plan for the Al-Amin Living Lab and Industrial Park (Evans et al., 2015 ; Leal Filho et al., 2022).

At the time this study was conducted, detailed contour data that could serve as a reference for the planning process were not yet available (Saleh et al., 2015). The absence of such data creates an information gap regarding the characteristics of the landform, particularly in understanding the constraints and potential of the site to be developed for educational, tourism, and economic activities (Papakonstantinou et al., 2021). Consequently, the preparation of an accurate topographic map is an urgent necessity to ensure design precision and to support the implementation of sustainable architectural concepts (Ghilani & Wolf, 2011; Kelsey et al., 2015)..

This study presents an analysis of land contours for the planning of the Al-Amin Living Lab and Industrial Park in Sampe Cita Village, Kutalimbaru District. The novelty of this research lies in its application of geodetic GPS and advanced mapping software (Global Mapper) to generate high-precision topographic maps, which are critical for designing a sustainable, multifunctional area combining education, innovation, and eco-tourism. The objectives of the study are to assess the topography of the land, produce accurate elevation maps, and provide valuable data for zoning, building placement, and circulation routes.

This study aims to identify and map the contour formations of the Al-Amin Living Lab and Industrial Park site through geodetic GPS–based measurements using a grid method and data processing with mapping software. The results are expected to produce a precise topographic map that will serve as the basis for site design analysis. Additionally, this study contributes by providing valid preliminary data for the development of an integrated, efficient, and environmentally conscious educational and eco-edu-tourism area.

METHODS

This study employs a quantitative descriptive approach aimed at obtaining an objective representation of the land contour conditions at the Al-Amin Living Lab and Industrial Park Glugur Rimbun in Sampe Cita Village, Kutalimbaru District. This approach was selected to produce accurate elevation and topographic data as the basis for site planning analysis.

The research was conducted on an area of approximately 20 hectares in Sampe Cita Village, Kutalimbaru District, Deli Serdang Regency. Field activities were carried out over a period of two months, including survey measurements, data validation, and contour data processing. The research location is shown on the site coordinate map included in the project documentation.

The research materials consist of: 1) Topographic data in the form of elevation points (X, Y, Z) covering the entire study area. 2) Physical site conditions, including land surface characteristics, vegetation, and existing land use. The primary equipment used includes: 1) Geodetic GPS, used for high-accuracy elevation point measurements. 2) Global Mapper software, used for contour data processing, elevation interpolation, slope analysis, and topographic map generation.

The research was conducted in the following stages: 1) Field survey, elevation point measurements were conducted using Geodetic GPS, with evenly distributed points across the study area. Mapping followed a grid pattern to ensure regularity and uniformity of measurement points. 2) Data collection, field data were compiled together with secondary data such as regional maps, literature references, and area planning documents. 3) Documentation, field activities were documented to complement spatial analysis and visually verify the topographic conditions. 4) Data processing, elevation point data (XYZ) were processed through interpolation, contour generation, and slope analysis using Global Mapper, resulting in a topographic map with a 50 cm contour interval. 5) Topographic analysis. 6) Data validation, validation was carried out by re-checking selected GPS points through sampling and by visual comparison using Garmin BirdsEye aerial imagery.

The contour measurement employed the grid method, in which the land was divided into squares with 20-meter intervals. Each grid point was measured for its elevation using Geodetic GPS. This method produces high-density data, thereby increasing the accuracy of the resulting contour lines. The denser the measurement points, the more precise the contour representation.

Data analysis was conducted quantitatively based on: 1) Elevation distribution. 2) Slope percentage. 3) Contour patterns. 4) Land segmentation based on topographic characteristics.

RESULTS AND DISCUSSION

Site Condition

The Al-Amin Living Lab and Industrial Park Glugur Rimbun site is located in Sampe Cita Village, Kutalimbaru District (Figure 1). The area is planned as a center for education, research, innovation, and eco-edutourism based on the concept of circular economy education. The site's diverse physical characteristics require accurate topographic data as a basis for large-scale development planning. Therefore, contour mapping serves as a fundamental stage for understanding the site's potentials and constraints prior to the masterplan design phase.

Elevation and Contour Analysis

The contour measurements were conducted using the grid method with a 20-meter spacing between measurement points. The collected field data were processed using Global Mapper software to produce a Topographic Map. The resulting map uses a contour interval of 50 cm. The topographic map shows that approximately 60% of the Al-Amin Living Lab & Industrial Park area—equivalent to around 12 hectares—consists of relatively flat terrain. Meanwhile, the remaining 40% (around 8 hectares) features steep or ravine-like contours. The relatively flat areas are located in the western and southern parts of the site, whereas the steeper areas are situated in the eastern and northern sections.

The slope conditions of the land are confirmed through the GRID visualization generated from the slope analysis in Global Mapper (Figure 3). The figure indicates that the majority of the site consists of gentle slopes, although certain areas exhibit steep gradients.

These steep areas are primarily located in the western and northern portions of the site, which correspond to locations adjacent to the river boundary.

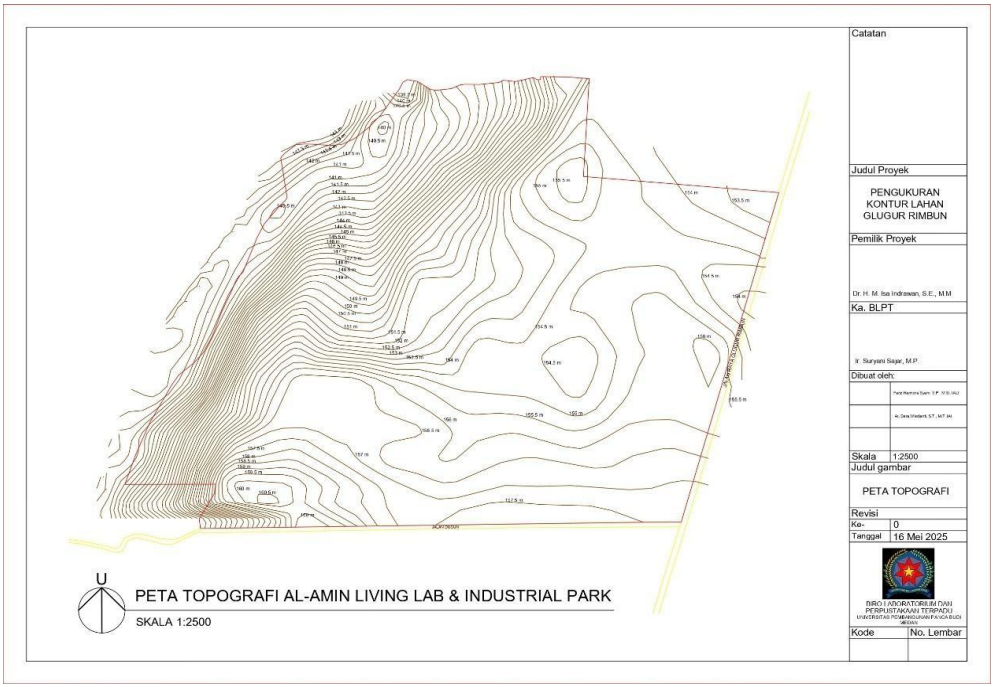

Figure 1. Topographic Map of the Al-Amin Living Lab & Industrial Park

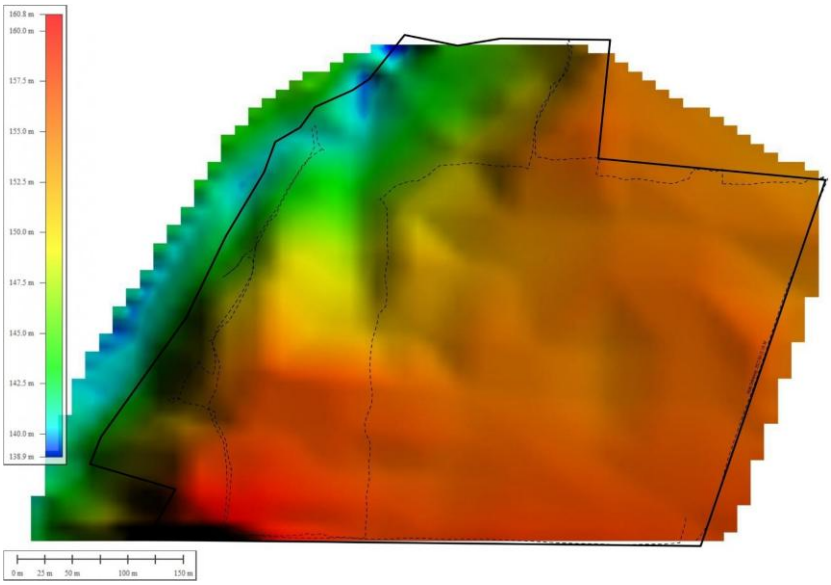

Figure 2. Land Slope Analysis in Global Mapper Software

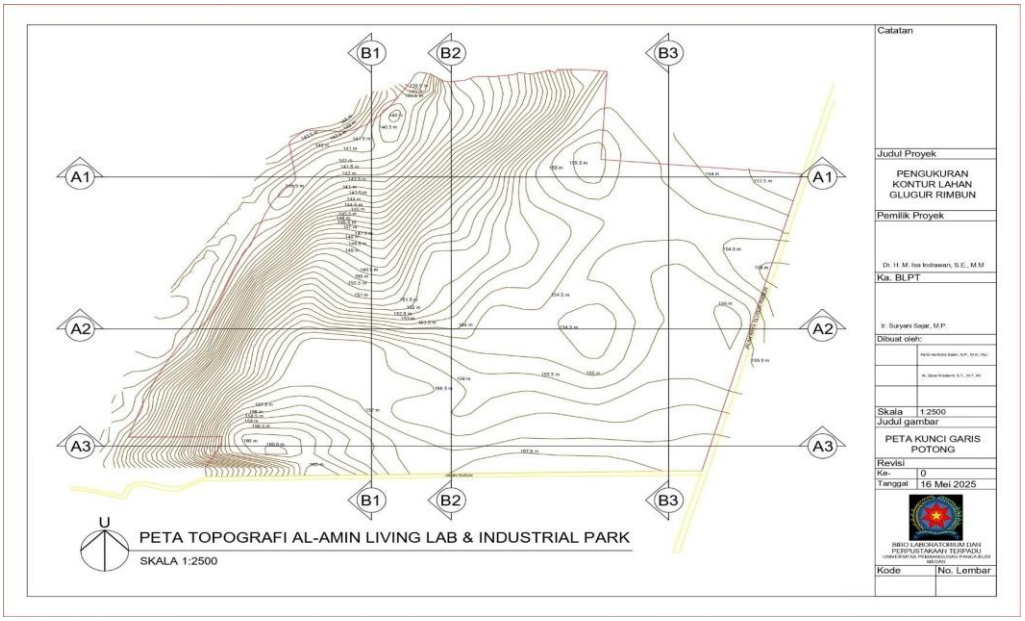

Figure 3. Topographic Map of the Al-Amin Living Lab & Industrial Park

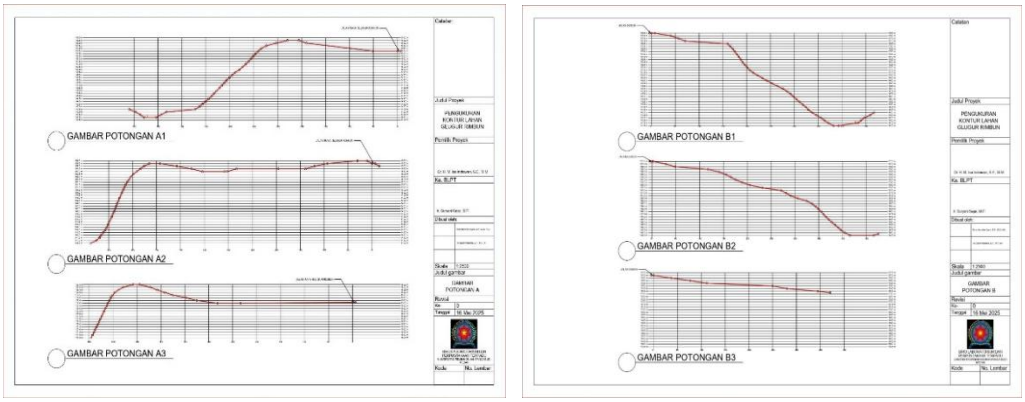

Figure 4. Section Drawing

Topographic Interpretation for Area Development

Slope analysis indicates that most of the land falls within the gentle to moderate slope categories, while the steepest slopes are found in zones adjacent to the river and natural escarpments. This pattern reinforces the interpretation that the site's morphological dynamics are shaped by local hydrological flows (Akbulak, 2010). The variation in land slope provides opportunities for functional differentiation within the area, while also requiring careful consideration in site-engineering strategies (Mishra et al., 2015). In areas with high slope gradients, design approaches must prioritize slope stability, surface drainage management, and mitigation against potential erosion (Mugnier et al., 2025).

The resulting topographic map functions as the primary basemap for the entire development of the Al-Amin Living Lab and Industrial Park. Approximately ±12 hectares of flat land present strong potential for the development of core facilities such as innovation centers, field laboratories, practical learning spaces, plazas, and visitor reception areas.

Meanwhile, the ±8 hectares of steep terrain are more suitable for use as green open spaces, conservation zones, or nature-based educational trails, thereby maintaining the ecological character of the site. Through this approach, the area's design can adhere to sustainable architectural principles by minimizing land engineering and maximizing design adaptation to natural conditions.

CONCLUSION

This study generated a precise contour map of the Al-Amin Living Lab and Glugur Rimbun Industrial Park site in Sampe Cita Village using geodetic GPS measurements at 20-meter grid intervals and Global Mapper processing, revealing that approximately 60% (±12 hectares) of the land features relatively flat contours ideal for main facilities, while the remaining 40% (±8 hectares) consists of steep terrain near river channels suited for green spaces, conservation, or nature trails. These topographic variations inform critical planning aspects, including building placement, circulation, drainage, and site engineering, ensuring designs adapt to natural conditions and adhere to sustainable architectural principles. The resulting map provides an essential basemap for developing this educational, innovative, and eco-edutourism area, serving as a foundational reference for future implementation. For future research, integrating hydrological modeling with this contour data could optimize flood risk assessment and water management strategies, enhancing the site's long-term resilience.

REFERENCES

Akbulak, C. (2010). Analiz of land use changes in the Manyas Lake Basin Area. *Environmental Monitoring and Assessment, 165*(1-4), 671-685.

Aharonian, F., Akhperjanian, A. G., Aye, K.-M., Bazer-Bachi, A. R., Beilicke, M., Benbow, W., Berge, D., Berghaus, P., Bernlöhr, K., & Bolz, O. (2004). Calibration of cameras of the HESS detector. *Astroparticle Physics, 22*(2), 109-125.

Azka. Membuat Kontur Menggunakan Global Mapper: Panduan Lengkap. https://tekniksipil.id/membuat-kontur-menggunakan-global-mapper/

Baraban, R. S., & Durocher, J. F. (2010). *Successful restaurant design*. John Wiley & Sons.

Bookhart, D. (2025). Accelerating sustainability innovation through a living lab research framework. In W. L. Filho, J. Newman, A. Lange Salvia, L. Viera Trevisan, & L. Corazza (Eds.), *North American and European perspectives on sustainability in higher education* (pp. 431-450). Springer. https://doi.org/10.1007/978-3-031-80434-2_24

BPS Deli Serdang. (2021). *Kecamatan Sunggal Dalam Angka*.

Coleman, S. R. (2006). Structural fat grafting: More than a permanent filler.

Council, F. F., & Council, N. R. (2002). *Learning from our buildings: A state-of-the-practice summary of post-occupancy evaluation* (Vol. 145). National Academies Press.

Evans, J., Jones, R., Karvonen, A., Millard, L., & Wendler, J. (2015). Living labs and co-production: University campuses as platforms for sustainability science. *Current*

Opinion in Environmental Sustainability, 16, 1-6. https://doi.org/10.1016/j.cosust.2015.06.005

Ghilani, C. D., & Wolf, P. R. (2011). *Elementary surveying: An introduction to geomatics* (13th ed.). Pearson.

Gözenç, S. (1978). *Türkiye'nin toprak coğrafyası*. İstanbul Üniversitesi Yayınları.

Herth, S., Müller, L., & Wanner, M. (2025). The innovation power of living labs to enable sustainability transitions: Challenges and opportunities of on-campus initiatives. *Creativity and Innovation Management, 34*(1), 42-58. https://doi.org/10.1111/caim.12649

Husna, A., & Satria, I. (2019). Effects of return on asset, debt to asset ratio, current ratio, firm size, and dividend payout ratio on firm value. *International Journal of Economics and Financial Issues, 9*(5), 50-54.

Jankowski, P., & Richard, L. (1994). Integration of GIS-based suitability analysis and multicriteria evaluation in a spatial decision support system for route selection. *Environment and Planning B: Planning and Design, 21*(3), 323-340.

Kelsey, H. M., Ladinsky, T. C., Bemis, S. P., Crosbie, J. A., & Gillem, L. M. (2015). Topographic surveys of landslides using RTK GPS. *Geosphere, 11*(6), 1811-1825.

Leal Filho, W., Salgueirinho Osório de Andrade Guerra, J. B., Sima, M., Salvia, A. L., Frankenberger, F., & Dibbern, T. (2022). Living labs in the context of the UN sustainable development goals: State of the art. *Sustainability Science, 17*(6), 2335-2350. https://doi.org/10.1007/s11625-022-01240-w

Martyn, A., Openko, I., Ievsiukov, T., Shevchenko, O., & Ripenko, A. (2019). Accuracy of geodetic surveys in cadastral registration of real estate: Value of land as determining factor. In *18th International Scientific Conference Engineering for Rural Development* (pp. 22-24). https://doi.org/10.22616/ERDev2019.18.N236

Mishra, A. K., Deep, S., & Choudhary, A. (2015). Identification of suitable sites for organic farming using AHP & GIS. *Egyptian Journal of Remote Sensing and Space Sciences, 18*(2), 181-193.

Mugnier, C. J., Smith, D. A., & Roman, D. R. (2025). Large-scale topographic mapping using RTK-GNSS and multispectral UAV drone photogrammetric surveys: Comparative evaluation of experimental results. *Geomatics, 5*(2), 25. https://doi.org/10.3390/geomatics5020025

Muzzayana, S. (2013). Model Terrain Digital (MTD) "Pengenalan Gridding Method". https://www.slideshare.net/slideshow/metode-griddingpadasoftwaresurfer/76626645

National Research Council. (2010). *Precise geodetic infrastructure: National requirements for a shared resource*. The National Academies Press. https://doi.org/10.17226/12954

Ongkohadi, Y. (2014). Perancangan interior magnum kafe di Surabaya. *Jurnal Intra, 2*(2), 421-425.

Papakonstantinou, A., Batsaris, M., Spondylidis, S., & Topouzelis, K. (2021). A citizen science unmanned aerial system data acquisition protocol and deep learning techniques

for the automatic detection and mapping of marine litter concentrations in the coastal zone. *Drones, 5*(1), 6. https://doi.org/10.3390/drones5010006

Richi, A. (2025). Soil erosion assessment using machine learning models in the Ghamima River Basin, Morocco. *Land Degradation & Development, 36*(3), 1234-1250.

Saleh, A. M., Belal, A. B., & Mohamed, E. S. (2015). Land resources assessment of El-Galaba basin, South Egypt for the potentiality of agriculture expansion using remote sensing and GIS techniques. *Egyptian Journal of Remote Sensing and Space Sciences, 18*(1), S19-S30.

Saleh, A. M., Ibrahim, M. M., & Abd El-Rahman, M. A. (2025). Enhancing land suitability assessment through integration of AHP and GIS-based for efficient agricultural planning in arid regions. *Scientific Reports, 15*, 31370. https://doi.org/10.1038/s41598-025-14051-7

Sestraș, P., & Roșca, S. (2024). Modern geospatial data acquisition, tools and applications in interdisciplinary research. *Applied Sciences, 14*(12), 5124.

Sumargo, P. S. (2003). Penerapan Konsep Mixed-Use dalam Pengembangan Kawasan Kota. Depok: KILAS Jurnal Arsitektur FTUI. Hal, 58.

Syam, F. H., Wisdianti, D., Sajar, S., & Bahri, S. (2023, July 3). ARSITEKTUR BERKELANJUTAN (Studi Kasus: Living Lab di Kecamatan Kutalimbaru). https://tahtamedia.co.id/index.php/issj/article/view/311

Syam, F. H., Wisdianti, D., Sajar, S., & Bahri, S. (2023). Designing Living Lab Area With Sustainable Architecture Concept. *The International Conference on Education, Social Sciences and Technology, 2*(1), 42-51. https://doi.org/10.55606/icesst.v2i1.264

Thapa, N., Pant, P., Prasai, R., & Ghimire, B. (2025). Sustainable land use planning in developing countries using GIS and multi-criteria analysis: A case study of Lalitpur district, Nepal. *City and Built Environment, 3*, 13. https://doi.org/10.1007/s44213-025-00050-x

Virgiantidesvir. (2013). Metode Grid. https://virgiantidesvir.blogspot.com/2013/10/metode-grid.html

Waghs, R. V., & Sharad, M. (2025). The role of geographic information systems (GIS) in land use planning. *International Journal of Innovations in Science Engineering and Management, 4*(1), 45-62.

Wang, Z., & Wang, Y. (2015). Research on Vertical Space System of Mixed-Use Complex. *International Journal of High-Rise Buildings, 4*, 153-160.