



Enhancing Rural Connectivity: Road Accessibility Mapping in Nagari Lawang Using Geographic Information Systems (GIS)

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ABSTRACT

Road infrastructure is a crucial element in supporting socio-economic growth, particularly in rural areas such as Nagari Lawang, Agam Regency, West Sumatra. This article discusses efforts to map road conditions in Nagari Lawang using Geographic Information Systems (GIS). The objective of this mapping is to enhance road accessibility, which can support the economic growth of the local community, especially in the agriculture and tourism sectors. The methodology includes road accessibility surveys and data analysis using ArcGIS software. Survey results indicate that the roads in Nagari Lawang are predominantly concrete with an average width of 2 meters, while dirt roads are narrower and mainly used as farm roads. The resulting map is expected to assist the government in more targeted and equitable development planning. This road mapping not only supports infrastructure development but also aligns with the Merdeka Belajar Kampus Merdeka (MBKM) program as a collaborative effort in regional development to the head of the Lawang village government.

Keywords: Lawang village, road accessibility, geographic information system (GIS)

INTRODUCTION

Road infrastructure is a fundamental necessity for communities in achieving socio-economic development (Awaliani et al., 2024). Well-maintained roads facilitate the smooth functioning of economic activities by improving accessibility between city service centers, sub-centers, and local neighborhoods (Purnawati et al., 2017). Moreover, road accessibility impacts not only physical mobility but also access to education, healthcare, employment, and other essential services. Therefore, improving road accessibility constitutes a critical component of the Sustainable Development Goals (SDGs), particularly in the context of infrastructure development, mobility, and social inclusion (Ihza dirgantara aji & Jihadul Akbar, 2023; Praditya et al., 2022)

One region that prioritizes road accessibility in its strategic development plan is Agam Regency, especially in border areas adjacent to neighboring provinces or regions with tourism potential. One such area is Nagari Lawang, which is geographically situated as an alternative transit corridor and lies close to the tourist destination of Lake Maninjau (Dinas Pariwisata Pemuda dan Olahraga Kabupaten Agam, 2024). To support this strategic development plan, accurate data on road damage conditions in Nagari Lawang is essential.

However, as of now, no updated and inventoried data regarding the road conditions in Nagari Lawang is available. Consequently, collecting and processing data on the quality and quantity of road accessibility in the area is necessary to develop a comprehensive and accessible mapping of Nagari Lawang's road network.

Nagari Lawang is located in the Matur District of Agam Regency, West Sumatra Province. Geographically, it lies in a highland area within the Bukit Barisan mountain range, characterized by hills, valleys, and limited lowland areas. The region is divided into six administrative hamlets (jorong): Katapiang, Gajah Mati, Lawang Tuo, Buayan, Pabatuangan, and Batu Basa. Nagari Lawang possesses abundant natural resources, particularly in the agricultural sector. Thus, adequate road accessibility is essential to facilitate the transportation of agricultural products (PU, 2021). In this context, accessibility refers to the degree to which an area can be reached both physically and non-physically by external parties (Adelino et al., 2015; Pasaribu, 2013). Improved accessibility is expected to contribute to increased income for the residents of Nagari Lawang.

One viable method to address this issue is to utilize Geographic Information System (GIS)-based road condition mapping (Praditya et al., 2022). This system serves as a road database solution, supporting the development of a more valid and systematically planned data infrastructure (Purwanto & Iswandi, 2019). The surveyed road conditions will be mapped using an integrated GIS platform that provides detailed and large-scale information on road accessibility in Nagari Lawang. This system will be accessible from anywhere. The expected outcome of this GIS-based road condition mapping is the production of an accessibility map of Nagari Lawang, which can serve as a foundational reference for strategic planning, potential development, and local promotion efforts aimed at enhancing the region's economy and community welfare.

METHOD

This activity was conducted in Nagari Lawang, Matur District, Agam Regency, in September – December 2023. The initiative aimed to assess and map the road accessibility in the region, which is essential for supporting both economic activities—particularly agriculture—and daily mobility. The activity was implemented in two key stages: (1) a road accessibility identification survey in Nagari Lawang and (2) mapping of road accessibility using Geographic Information System (GIS)-based mapping principles. During the first stage, a detailed field survey was conducted to assess the current state of the road network in Nagari Lawang. The survey methodology involved direct site observations and GPS-based data collection using the Avenza Maps application. This stage was carried out collaboratively with seventeen students participating in the Merdeka Belajar Kampus Merdeka (MBKM) program, integrating academic learning with practical fieldwork (as shown in Figure 1). The survey involved tracking and logging the paths and roads, particularly those that are commonly used by residents, including agricultural routes and village access roads.



Figure 1. Road condition tracking activity for data collection and mapping purposes.

The second stage involved the processing and analysis of the collected data using ArcGIS 10.7, a Geographic Information System (GIS) software (Afnarius et al., 2020). The spatial data captured through Avenza Maps 5.4.1 (228) Build dev ARCH64 was imported into ArcGIS (Ratnasari et al., 2025), where several processes were conducted:

- Data cleaning and intersection were performed to resolve overlapping line features, ensuring accurate measurement of road lengths.
- Digitization and visualization steps included adding base map imagery of Nagari Lawang to provide geographic context.
- Map layout and symbology design were conducted to clearly differentiate road types and conditions.

The final output of this activity was a comprehensive road accessibility map of Nagari Lawang, featuring both, qualitative and quantitative data. Qualitative data were such as the typology of road surfaces (e.g., asphalt, concrete, or dirt roads) and physical conditions, while quantitative data were such as total road lengths categorized by surface type and condition. This GIS-based map serves as a valuable resource for local authorities, providing spatial insights that can guide future infrastructure planning and equitable rural development, especially in improving transportation access for farming and daily life.

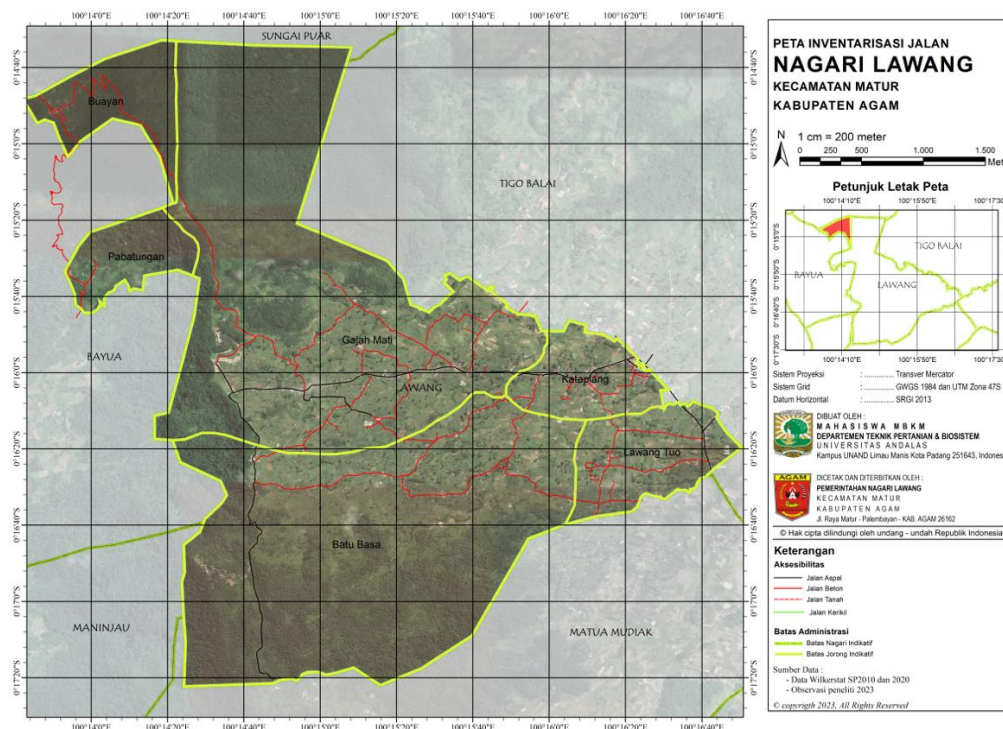
RESULTS AND DISCUSSION

Based on the findings of the accessibility survey conducted during the community service initiative, it was determined that the road network in Nagari Lawang consists of a variety of road surface types. The primary categories identified are asphalt roads, concrete roads, and dirt roads, each playing a different role in serving the transportation needs of the local population. These categories are visually represented in Figure 2.



Figure 2. Road conditions by type: (a) Asphalt road, (b) Concrete road, and (c) Dirt road.

As shown in the figure, dirt roads generally have narrower widths compared to the other two types. Among these, concrete roads emerged as the most prevalent type, distributed extensively across all jorong (hamlets) within the nagari. These roads typically measure about 2 meters in width, making them suitable for pedestrian use and limited vehicular traffic such as motorcycles and agricultural equipment. Asphalt roads are generally located in more developed or central parts of the village, while dirt roads—often narrower and less stable—are found in more remote or undeveloped zones. Furthermore, the field observations revealed that concrete roads function primarily as agricultural access roads (jalan usaha tani), forming critical pathways that connect farmers to their fields. These roads are instrumental in supporting the local economy, especially considering that agriculture remains a dominant livelihood in Nagari Lawang. Their availability and condition directly influence farming efficiency, ease of transporting goods, and overall rural productivity (Lokesha MN & Mahesha M, 2016).



Service Figure 3. Road accessibility map of Nagari Lawang.

From a spatial planning perspective, the road inventory map developed from this activity plays a crucial role. Presented in Figure 3, the map offers digital spatial data that highlights not only the geographical distribution of roads, but also provides insights into the location of settlements, agricultural zones, and underdeveloped forest areas. The mapping process was supported by Avenza Maps for data collection and ArcGIS for data analysis and visualization (Afnarius et al., 2020).

The resulting road map, drawn at a 1:200 scale, demonstrates that road density is higher in regions with established settlements and agricultural activities. These areas benefit from relatively better access and infrastructure, which contributes to their socio-economic vitality. In contrast, areas with sparse road coverage—particularly community forest zones or highland terrain—face accessibility limitations, potentially hindering the delivery of services, resource management, and economic development in those regions (Fan & Chan-kang, 2004; Nasution & Amri, 2025).

Based on the mapping some strategic plans, such as infrastructure planning (Salim & Faoziyah, 2022), disaster risk management, agricultural optimization, and tourism and mobility, can be planned for developments implications in the future. The plans would enhance the accessibility in Nagari Lawang, which importance for equitable rural development (Wahyuni et al., 2022). Regarding to the infrastructure planning, the road typology data can be used by local governments to prioritize infrastructure investments, focusing on improving dirt roads or expanding access to remote areas. Meanwhile, the informative road map would also be useful as an aid in emergency response planning, especially in flood-prone or landslide-risk areas (Lokesha MN & Mahesha M, 2016; Widodo, 2021). Improved access to farmland can reduce transport costs and post-harvest losses, increasing productivity for farmers and optimize the agricultural sector. In addition, as Nagari Lawang has potential for eco-tourism, accessible roads are essential to attract visitors and facilitate local economic diversification.

CONCLUSION

The condition and accessibility of roads are crucial components in supporting the social and economic development of communities, particularly in rural areas such as Nagari Lawang, Agam Regency, West Sumatra. To achieve optimal accessibility, it is essential to map the road conditions using Geographic Information Systems (GIS). This mapping activity not only constitutes part of a community service initiative integrated with the Merdeka Belajar Kampus Merdeka (MBKM) student program but also aims to provide accurate information regarding the current state of the road network. Such data is expected to serve as a foundational reference for regional development and infrastructure planning. Ultimately, the mapping outcomes are anticipated to improve overall accessibility and support local economic growth—particularly in the agricultural and tourism sectors

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