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Spatial Mapping of Facilities and Infrastructure Using GIS in Pasar Tanjung Enim Village, Muara Enim Regency

Putra[1], Astrid Fadhilah[2]

[1,2]Teknik Pengolahan Hasil Tambang Mineral dan Batubara, Akademi Komunitas Industri Pertambangan Bukit Asam, Indonesia

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ABSTRACT

Geospatial information and community participation in regional development at various levels, including villages/subdistricts, are currently required to support economic growth and community empowerment. Good planning (based on digital and spatial information) and community participation in community management are presently needed. By utilizing digital and spatial information presented in maps and resource information, geographical locations can be easily identified. This study aims to map resources and infrastructure in Pasar Tanjung Enim Village based on geospatial information and community participation. Specifically, this research aims to provide a database and base maps of high-resolution satellite imagery and thematic maps of resources and infrastructure at the village level (large-scale and detailed), both in digital and hardcopy formats, with the involvement of community participation, and compiled into a village potential map album. Data was collected using spatial data from the Muara Enim Public Works and Spatial Planning Agency, infrastructure surveys with handheld GPS devices, and ESRI satellite imagery as base maps. Spatial data collection and field validation resulted in 148 attribute data. The results of this study are 11 thematic maps at a scale of 1:15,000, namely administrative village maps containing information on area size and boundaries, land cover, and infrastructure (road networks, telecommunications networks, government offices, places of worship, health facilities, commercial facilities, educational facilities, and public facilities). The success of this mapping supports replication in other regions. It aligns with the one map policy, emphasising spatial integration and community participation in data-driven village development.

Corresponding Author:

Putra,
Teknik Pengolahan Hasil Tambang Mineral dan Batubara,
Akademi Komunitas Industri Pertambangan Bukit Asam,
Jl. Bukit Munggu No. 1 Kel. Pasar Tanjung Enim Kec. Lawang Kidul, Kab. Muara Enim, Sumatera Selatan, 31713, Indonesia.
Email: putra@akipba.ac.id

1. INTRODUCTION

Indonesia has a total of 75,753 villages, 8,486 urban villages, and 37 Transmigration Settlement Units/Transmigration Settlement Units based on the results of the 2024 Village Potential Census (Podes). Each village/muara enim has the potential for

resources, humans, institutions, facilities, and infrastructure that are large enough to support the acceleration of achieving community welfare (Anshar & Zulkifli, 2019). According to Mujiyadi et al., (2017) the majority of Indonesia's population lives in villages, but their resource potential has not been utilized properly, and they generally live in poverty. Therefore, national development focusing on villages is very important to strengthen the country's economy, reduce poverty, and reduce the gap between towns and cities (Diah, 2020).

Village development planning is a crucial aspect of village administration (Simarmata & Zarkasi, 2019). Therefore, good planning (based on digital and spatial information) and community participation are currently needed to manage potential resources to support economic development and community empowerment (Wibowo & Sarkowi, 2022). By utilizing digital and spatial information presented in the form of maps and digital information (Putra & Wirandha, 2024), the geographical location, type, area, and distribution of resource data and information can be easily identified (Handayani & Cahyono, 2014). In addition, this data and information can be well documented, easily processed, and updated if necessary or changes occur. Furthermore, involving the community can enhance a sense of ownership and ensure targeted planning and decision-making that considers the community's interests (Srirejeki et al., 2020).

Geospatial data is crucial to the Geospatial Information Act No. 4 of 2011 in regional development, especially in rural areas. Spatial data with geographical references facilitates the integration of attribute data into spatial units (Sumarno, 2014). The use of spatial data is expanding with advances in digital mapping technology and Geographic Information Systems (GIS) (Erkamim et al., 2023). Spatial data, which is a key component of GIS, can be obtained from various sources, including analogue maps, remote sensing data such as satellite imagery and aerial photographs (which are the primary sources of data due to their wide coverage and periodic availability), field measurement data, and GPS data, which is becoming increasingly accurate (Putra & Fadhilah, 2023). These various data sources enable more comprehensive and precise spatial analysis (Musyary & Nouri, 2024), particularly in the Spatial Mapping of Infrastructure Facilities in the Pasar Tanjung Enim Village, Lawang Kidul Subdistrict, Muara Enim District, South Sumatra. This data integration supports identifying and visualising infrastructure distribution in detail, which ultimately serves as a basis for informed decision-making in targeted and sustainable regional development planning (Meidodga et al., 2023).

Pasar Tanjung Enim Village is one of 3,263 villages in South Sumatra Province (South Sumatra Provincial Statistics Agency), administratively located within Lawang Kidul Subdistrict, Muara Enim Regency (Muara Enim Regency Statistics Agency). With an area of 6.6 km^2, this subdistrict has potential resources and infrastructure for education, health, offices, roads, sports facilities, and others. The local government has undertaken several initiatives, including GIS training, non-spatial village potential mapping, boundary mapping, and toponymic data compilation. However, these initiatives remain partial and have not been systematically integrated. Spatial data is not yet connected to the village statistics database, GIS implementation has not reached the Tanjung Enim Market Village, and the capacity of officials to manage geospatial data is still limited. This situation has resulted in the potential of the area not being optimally inventoried based on geospatial information. Until now, the existing database, including that provided by the local government through the Central Statistics Agency in the region (Muara Enim Regency), has been limited to statistical data/figures and is not based on a geographic/spatial information system. The challenges faced are the lack of awareness and uneven distribution of knowledge among village government officials and the community regarding information technology, its potential, and related regulations (Handayani & Cahyono, 2014). The urgency of using GIS in Pasar Tanjung Enim Village is higher than in surrounding villages due to its urban, dynamic, and multifunctional

characteristics. GIS provides vital spatial information for spatial planning, public services, environmental mitigation, and development planning. Additionally, implementing GIS can serve as the initial foundation for becoming a smart village, aligning with the digital transformation agenda of village governance (Prawiro et al., 2024).

This study aims to map and analyze the distribution of facilities and infrastructure in Pasar Tanjung Enim Village using a GIS approach. The main focus of this study is to present spatial information regarding road networks, telecommunications networks, government offices, land cover, and educational, health, religious, commercial, and general facilities. The main issues addressed in this study are the condition and distribution of infrastructure in the area and how GIS can be optimally utilized in the mapping and analysis process. The results of this study are expected to provide tangible contributions to local governments, communities, academics, and other stakeholders in achieving more equitable, efficient, and sustainable regional planning.

2. RESEARCH METHOD

This study was conducted in Pasar Tanjung Enim Village, Lawang Kidul Subdistrict, Muara Enim Regency, and data collection was carried out in June 2025. Pasar Tanjung Enim Village is one of seven villages in the Lawang Kidul Subdistrict (Figure 1).

Figure 1. Google Satellite Image Map of Pasar Tanjung Enim Village, Lawang Kidul Subdistrict, Muara Enim Regency, South Sumatra

The steps taken in this research are shown in the following flow chart (Figure 2).

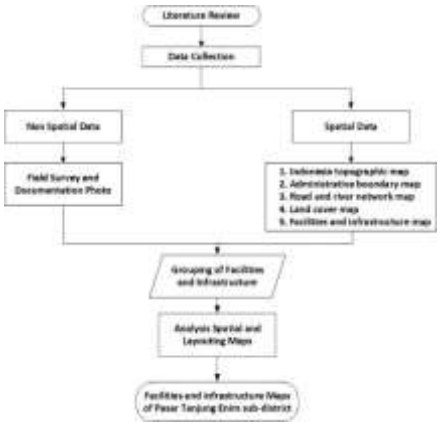

Figure 2. Research Flow Chart

This research was conducted in several stages to achieve the research objectives, namely the preparation stage, data collection stage, data processing stage, data analysis stage, and completion stage.

2.1. Preparation Stage

This preparatory stage includes a literature review, preparation of data and equipment used for research, and preparation of equipment for field surveys. The following equipment was used in this study: 1) Laptop hardware is used to store data and process all spatial data used; 2) The GPSMAP 64s GARMIN Handheld marks points for facilities and infrastructure. The satellite navigation system provides accurate, real-time, three-dimensional position and speed information and can be used by multiple users in all weather conditions; 3) QGIS 3.12 software processes spatial data into maps because it is stable as a Long-Term Release (LTR), supports important plugins, has complete spatial analysis features, is compatible with various data formats, and is open source and lightweight, making it ideal for village mapping; 4) Microsoft Word software was used to create reports; 5) The Android GPS Map Camera application was used to document facilities and infrastructure;

2.2. Data Collection Stage

The data collection stage is collecting both spatial and non-spatial data. The data used in this study are: 1) The data collection stage is collecting both spatial and non-spatial data. The data used in this study are; 2) Spatial data on the topography of Indonesia, administrative boundaries of villages/subdistricts in Muara Enim Regency, road and river networks, land cover, and infrastructure. All spatial data was obtained from the Public Works and Public Housing Agency of Muara Enim Regency; 3) Non-spatial data consists of photo documentation data of objects, object name data, and object classification data.

2.3. Data Processing Stage

The data processing stage involves processing both spatial and non-spatial data to obtain parameters used to create a map of facilities and infrastructure in the Pasar Tanjung Enim Village. The data processing stage includes determining the coordinates of object locations on the base map and classifying the types of facilities and infrastructure. The results are then compiled into a digital village map by digitizing objects based on their appearance on the ESRI Satellite base map. Digitization produces spatial data and thematic maps in ESRI shapefile format (*.shp, *.shx, *.dbf) accompanied by WGS-84 datum and UTM projection information with adjusted zones. A spatial database (shapefile) is also created, complete with attribute information such as x and y coordinates, administrative boundaries of villages/subdistricts, land use areas, road network lengths, and river areas. The information displayed for each visualized or laid-out object refers to PERBIG No. 3 of 2016 regarding Technical Specifications for the Presentation of Village Maps.

2.4. Data Analysis Stage

The data analysis stage is very important in this study, using methods such as clipping, overlay, and spatial classification. The clipping method is used to cut existing spatial data based on the location of the research area, namely Pasar Tanjung Enim Village. The overlay method combines multiple spatial data layers, such as road networks and river networks, with the locations of educational facilities, enabling the analysis of the relationship between infrastructure and facilities. The overlay method is sufficient for the initial stages of mapping and visualizing facility and infrastructure space. It combines various data layers, such as administrative boundaries, land use, and facility locations (education, health, economy, and general), for spatial inventory, distribution visualization, and public service accessibility. This is very useful in understanding infrastructure equity gaps at the village level. Spatial analysis also includes identifying the distribution of facilities in a specific area, allowing researchers to identify well-served areas and those that still require development interventions.

2.5. Completion Stage

The completion stage is the final stage of this research. This stage results from the data analysis stage, namely spatial data that has been analyzed and then visualized (layouting) in thematic maps. The thematic maps referred to are Road Network Map, Telecommunications Network Map, Government Office Map, Land Cover Map, Educational Facilities Map, Health Facilities Map, Commercial Facilities Map, Religious Facilities Map, and General Facilities Map. Each map is accompanied by a legend, scale, and spatial annotations to facilitate data interpretation by various stakeholders. The A0-sized printouts of the Administrative Map were distributed to the Tanjung Enim Market Subdistrict Office and published in a village potential map album.

3. RESULTS AND DISCUSSIONS

3.1. Area and Boundaries of the Village

The Pasar Tanjung Enim Village covers an area of 565.545 ha. Lingga borders the North of this sub-district, while Tanjung Enim borders it to the South and West, and Tegal Rejo village is located East (Figure 3).

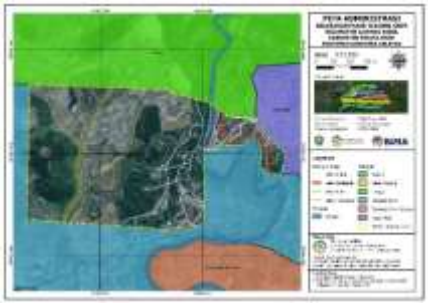

Figure 3. Administrative Map of Pasar Tanjung Enim Village, Lawang Kidul Subdistrict, Muara Enim Regency, South Sumatra

3.2. Land cover

The types and areas of land cover in Tanjung Enim Village are shown in Table 1 below.

Table 1. Land Cover in Tanjung Enim Village

No	Land cover	Area (Ha)	Percentage (%)
1	Lake Water / Situ	3.646	0,65%
2	Freshwater River	6.489	1,15%
3	Plantation / Garden	93.668	16,58%
4	Settlements and Activity Areas	119.840	21,21%
5	Mining	317.778	56,25%
6	Scrub / Grass	0.163	0,03%
7	Fields / Farmland	23.322	4,13%
	Total	564.906	100%

Land cover in Pasar Tanjung Enim Village is dominated by mining, which covers 317,788 ha or 56.25% of the total area, followed by settlements and activity sites covering 119,840 ha or 21.21%. For further details, see Figure 4.

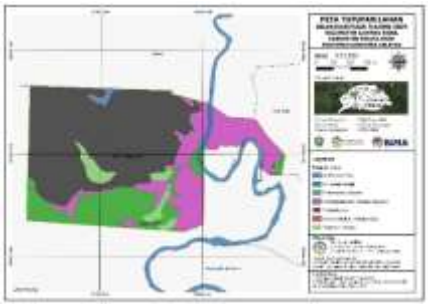

Figure 4. Land Cover Map of Pasar Tanjung Enim Village

3.3. Infrastructure and Facilities

a. Road Network

The road network in Pasar Tanjung Enim Village consists of national, local, and mining roads. The national and regional roads are in fairly good condition, with paved surfaces, and are integrated with roads leading to other villages/kelurahan and Muara Enim Regency (Figure 5).

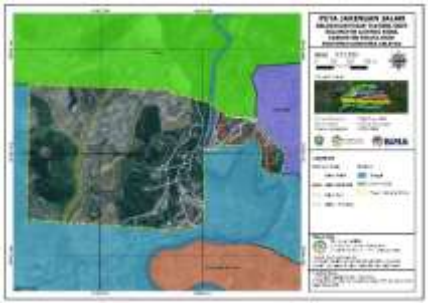

Figure 5. Road Network Map of Pasar Tanjung Enim Village

b. Telecommunications Network

Telecommunications lines, towers, and Base Transceiver Stations (BTS) are critical infrastructure components supporting wireless communication systems in the digital age (Chandra et al., 2024). Telecommunications lines link user devices and the core network through signals transmitted directly or via transmission media such as optical fiber cables or radio waves (Qathrunada & Hamidy, 2023). The Pasar Tanjung Enim Village has three telecommunications towers: the XL Tower, the Telkomsel Tower, and the Indosat Tower (Figure 6).

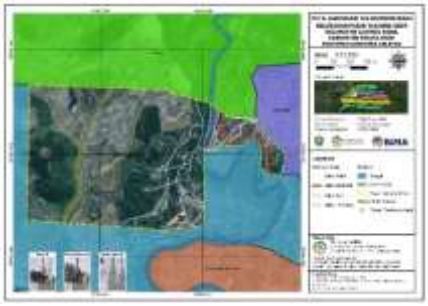

Figure 6. Telecommunications Network Map of Pasar Tanjung Enim Village

c. Public Facilities

The public facilities available and spread across the Pasar Tanjung Enim Village reflect the local government's efforts to provide public facilities that support social, sports, and recreational activities for the community. Three sports buildings can be used

for indoor activities, two sports fields support outdoor physical activities, and three monuments serve as local history and identity markers. In addition, there is a cemetery that is an important facility for the community and four playgrounds that provide space for children to play and socialize. The distribution of these facilities indicates the equitable development of public facilities to improve residents' quality of life in Pasar Tanjung Enim Village (Figure 7).

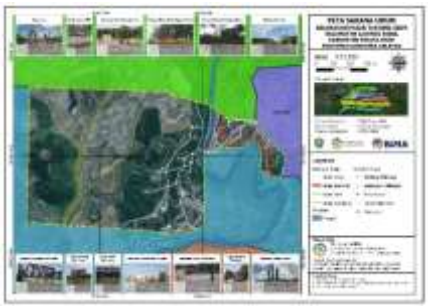

Figure 7. Public Facilities Map of Pasar Tanjung Enim Village

d. Facilities

The educational facilities in Pasar Tanjung Enim Village demonstrate the diversity of academic levels and institutions supporting sustainable human resource development. In this area, seven early childhood education institutions (PAUD/TK) play an important role in shaping children's cognitive and character development. At the primary education level, five elementary schools (SD), comprising one public elementary school (SDN) and four private elementary schools, offer alternative educational options for the community. There are four junior high schools (SMP) for lower secondary education, while upper secondary education is represented by one institution equivalent to a senior high school (SMA/SMK). The village also has two private universities supporting higher education at the local level and one library as a literacy resource for the community. Additionally, two training and course institutions complement the non-formal education system to enhance skills and competencies in the community outside the formal education system (Figure 8).

Figure 8. Educational Facilities Map of Pasar Tanjung Enim Village

e. Worship Facilities

The religious facilities in Pasar Tanjung Enim Village reflect the diversity and tolerance among religious communities that have grown within the local community. Six mosques are generally used for daily worship by Muslims in small neighborhoods or residential areas, as well as eight mosques that serve as centers for larger religious activities, including Friday prayers, religious lectures, and other social and religious activities. Additionally, three churches serve the spiritual needs of the Christian community in the area. The availability of adequate places of worship supports religious

activities and plays a crucial role in strengthening moral, social, and communal values within the community (Figure 9).

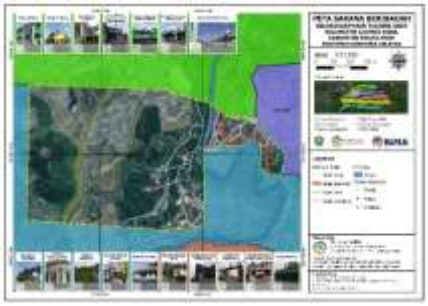

Figure 9. Map of Places of Worship in Pasar Tanjung Enim Village

f. Health Facilities

Health facilities are places or facilities that provide health services for individuals and communities. These facilities include various types of facilities that support health services, such as community health posts, community health centers, hospitals, health clinics, doctor/midwife practices, and pharmacies. The health facilities in the Pasar Tanjung Enim Village indicate efforts to provide comprehensive health services for the community, encompassing promotive, preventive, curative, and rehabilitative aspects. The following is a map of health facilities in the Pasar Tanjung Enim Village (Figure 10).

Figure 10. Peta Sarana Kesehatan Kelurahan Pasar Tanjung Enim

At the basic service level, there is one integrated health service post (posyandu) that functions as a community-based health center, especially for mothers and children. In addition, there is one community health center (puskesmas) as the first level health service unit that serves as the frontline in medical services in the area. For advanced medical care, there is one hospital providing inpatient services and more complex medical treatment. Furthermore, there are two health clinics and six doctor or midwife practices offering consultations and more personalized medical care. The presence of eight pharmacies further strengthens the supply chain for medications and medical equipment, collectively reflecting a fairly comprehensive and well-distributed healthcare system structure in Pasar Tanjung Enim Village.

g. Commercial Facilities

The commercial facilities in Tanjung Enim Village reflect the dynamics of the local economy, which is supported by trade and financial service infrastructure. A traditional market plays an important role as a center of economic activity for the community, a place for transactions of necessities, local products, and social interaction among residents. This market is not only a place for the distribution of goods but also has strategic value in supporting the people's economy and preserving traditional trading patterns. Additionally, eight bank branches indicate high access to formal financial services, including savings, loans, and other banking transactions. These financial

institutions contribute to local economic growth, increase financial literacy, and encourage micro, small, and medium enterprises (MSMEs) in the Pasar Tanjung Enim Village. The distribution of commercial facilities can be seen in Figure 11.

Figure 11. Map of Commercial Facilities in Pasar Tanjung Enim Village

h. Government Office

The existence of government offices in Pasar Tanjung Enim Village reflects the strategic role of this area as a center of administration and public services that supports the smooth functioning of government, security, and community services. The government facilities available include the Village Head's Office, which serves as the administrative center of the village government and is at the forefront of public service delivery and local governance. Additionally, there are the Police Station and Military Command Post, each fulfilling crucial roles in maintaining public safety, order, and territorial defense. The presence of the Water Supply Office (PDAM) and the Telkom Plaza Office further strengthens essential services such as clean water and telecommunications for residents. Furthermore, this area is also home to the offices of state-owned enterprises (SOEs), namely PT Bukit Asam Tbk., which not only serves as a strategic national business entity but also as a key player in local economic and social development through various partnership programs and corporate social responsibility (CSR) initiatives. The distribution of government offices can be seen in Figure 12.

Figure 12. Map of the Pasar Tanjung Enim Village Government Office

The success of this mapping indicates that the geospatial approach not only contributes to improving the accuracy of spatial data but also plays a role in building community awareness of the comprehensive potential of their region. These findings show potential for replication in other villages with similar characteristics. They align with national policy through the One Map Policy, which emphasizes the integration of spatial data and community involvement as key elements in development governance. Implicitly, the mapping results can serve as a foundation for evidence-based development planning, promote cross-sectoral integration in the formulation of the Medium-Term Village Development Plan (RPJMDes), and strengthen the institutional capacity of villages in managing the Regional Geospatial Information System (SIGD).

4. CONCLUSION

This study shows that the use of Geographic Information Systems (GIS) in the spatial mapping of facilities and infrastructure in Tanjung Enim Village produces comprehensive and structured information related to the distribution of regional infrastructure. Integrating spatial and non-spatial data and community participation in the mapping process has produced thematic maps illustrating the current conditions of road networks, telecommunications networks, government offices, land cover, and educational, health, religious, commercial, and general facilities. These findings support participatory planning and data-driven decision-making, with the potential for data updates, interactive applications, and expansion of the area for sustainable development. However, this study has limitations as the mapping was conducted within a specific timeframe, thus unable to capture the dynamic spatial changes that occur periodically, such as new developments, land use changes, or infrastructure additions. These limitations highlight the need for periodic data updates to support adaptive and sustainable development planning.

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