

A Mapping the Distribution and Accessibility of Midwifery Practices in Jembrana Regency in 2025 Using a Geographic Information System (GIS)

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Abstract. Background: Midwives play an important role in the implementation of antenatal care (ANC). However, disparities in the distribution of midwifery practices remain a significant issue. The distribution of midwifery practices in Jembrana Regency is still uneven. **Objective:** This study aims to analyze the distribution patterns and accessibility of midwifery practices in Jembrana Regency in 2025 using a Geographic Information System (GIS) approach. **Methods:** This study employed a cross-sectional spatial analysis using Geographic Information Systems (GIS) to examine the distribution patterns and geographical accessibility of midwifery practices and was conducted in Jembrana Regency from December 2025 to January 2026. The sample was selected using the total sampling method. Data analysis was carried out using Microsoft Excel and a Geographic Information System (GIS)-based application. **Results:** There are 458 midwifery practices in 91 locations, with 229 (50%) located in puskesmas. The distribution pattern is clustered, with hot spots at a 99% confidence level in Jembrana and Negara Sub-districts. The average distance from village centers to the nearest practice is 894,25 meters, with the shortest distance 32,50 meters. Two practice locations were not recorded by Dinas Kesehatan and Dinas PMPTSP of Jembrana Regency. **Conclusion:** The government needs to develop a needs-based distribution planning strategy for midwifery practices in each region to support equitable access to services.

Keywords: Accessibility; Distribution; Maternal and child health; Midwifery practice; Geographic Information System (GIS)



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Key Messages

- Spatial analysis identified a clustered distribution of midwifery practices in Jembrana Regency, with significant hot spots concentrated in urban sub-districts (Negara and Jembrana), while several rural villages lacked midwifery services and had substantially longer geographical access to the nearest practice.
- This study demonstrates the value of Geographic Information Systems (GIS) for identifying spatial inequities in the distribution and accessibility of primary maternal healthcare providers. The findings provide evidence that combining spatial distribution, accessibility, and population demand analyses can support more equitable planning of primary care services.

- GIS-based mapping should be incorporated into local health workforce planning to guide the equitable allocation of midwifery services. Priority should be given to underserved rural villages with limited geographical access to improve antenatal care accessibility and contribute to reducing maternal and infant health disparities.

1. Introduction

Maternal and child health is a key indicator used to assess a country's health status and constitutes an essential component in efforts to improve reproductive health [1]. Globally, issues related to maternal and child health have become a priority and are integrated into the United Nations's Sustainable Development Goals (SDGs), particularly Goal 3, which aims to ensure healthy lives and promote well-being for all at all ages [2]. To achieve this goal, there are 13 targets, with three primary targets related to maternal and child health: Target 3.1, which aims to reduce the Maternal Mortality Ratio (MMR) to below 70 per 100,000 live births; Target 3.2, which aims to reduce the Infant Mortality Rate (IMR) to 12 per 1,000 live births; and Target 3.7, which aims to ensure universal access to sexual and reproductive health services [3]. In Indonesia, these targets have been adopted into the National Medium-Term Development Plan 2020–2024 (RPJMN 2020–2024). However, national achievements still indicate that MMR and IMR have not yet met the targets established in the RPJMN [4].

One of the main strategies to reduce MMR and IMR is improving the quality of antenatal care (ANC) services. According to national regulations, ANC should be provided at least six times during pregnancy [5]. Nevertheless, the coverage of antenatal care visits (K4) in Indonesia in 2024 reached only 80.12%, indicating that the continuity of antenatal care utilization remains below the national target of 95% [5]. This low coverage is associated with various factors, including limited access and the unequal distribution of health workers [6],[7].

Antenatal care (ANC) services in Indonesia are provided through various healthcare facilities, including private midwifery practices, community health centers (puskesmas), clinics, and hospitals. Midwives working across these facilities play an important role in providing maternal and reproductive health services and improving community access to antenatal care. Midwives play a crucial role in the provision of ANC services. They are among the health professionals closest to the community and also contribute to empowering women through education and counseling [8]. Nationally, there remains a gap between the need for and the availability of midwives, as well as disparities in their distribution across regions [9],[10]. This issue is also observed in Bali Province, where several districts have not yet achieved the target ratio of midwives to population [11]. Jembrana Regency is one of the areas with a relatively

low midwife-to-population ratio (115,7 per 100,000 population) and the lowest ANC coverage in Bali Province [11].

The unequal distribution of health service facilities can affect service accessibility and increase the risk of maternal morbidity and mortality [12],[13]. Therefore, spatial analysis using a Geographic Information System (GIS) is required to comprehensively map the distribution and accessibility of midwifery practices. This study aims to analyze the distribution and accessibility of midwifery practices in Jembrana Regency in 2025 using a GIS-based approach to support planning for a more equitable distribution of midwifery services across regions.

2. Materials and Methods

This study employed a cross-sectional spatial analysis using Geographic Information Systems (GIS) to examine the distribution patterns and geographical accessibility of midwifery practices in Jembrana Regency. The study was conducted in Jembrana Regency from December 2025 to January 2026, with the accessible population consisted of all midwifery practices, including private midwifery practices, midwifery practices in community health centers (puskesmas), hospitals, and clinics which located in Jembrana Regency and recorded by the Jembrana Regency Health Office and the Investment and One-Stop Integrated Service Office (PMPTSP) based on the Midwife Practice License (SIPB).

The sampling method used was total sampling, with the sample consisting of all midwifery practices located in Jembrana Regency. The inclusion criteria were midwifery practices located within Jembrana Regency that were recorded by the Health Office and the PMPTSP Office based on the Midwife Practice License (SIPB) until December 2025. Meanwhile, the exclusion criteria included midwifery practices located in health facilities that are not accessible to the public, such as clinics within detention centers, and midwifery practices whose locations could not be validated through Google Street View or directly verified based on the address listed in the SIPB.

Data collection in this study consisted of secondary and primary data. Secondary data were obtained through official requests to the Jembrana Regency Health Office and the Jembrana Regency PMPTSP Office, as well as official publications from the Badan Pusat Statistik (BPS) of Bali Province. The collected data included addresses, types of midwifery services based on the Midwife Practice License (SIPB), total population, area size, population density, and the number of couples of reproductive age (PUS) per village in Jembrana Regency. In addition, coordinates of midwifery practice locations and village/urban village centers were also collected.

Geocoding of midwifery practice locations and village/urban village centers was performed by the researcher using address data obtained from the related institutions. The coordinates were obtained by tracing addresses using Google Maps

and subsequently validated through Google Street View. Primary data were collected through direct field observations when the coordinates of midwifery practices or village centers could not be validated through Google Street View or when inconsistencies were identified between the recorded addresses and actual locations. Locations that could not be spatially validated after the validation process were excluded from the analysis. These validation procedures were performed to ensure the spatial accuracy and reliability of the coordinate data used in the spatial analysis.

Data that had been validation process were subsequently stored in comma-separated values (CSV) format for spatial analysis using Geographic Information System (GIS)-based software. The analysis included descriptive analysis to describe the characteristics and distribution of midwifery practices, as well as spatial analysis aimed at visualizing the distribution of midwifery practices in the form of maps, measuring the nearest geographic access between village centers and midwifery practices, conducting nearest neighbor analysis to identify spatial distribution patterns, and performing hot spot analysis to detect areas with concentrations of midwifery practices.

3. Results and Discussion

Characteristics of Midwifery Practices

Based on the SIPB data for 2025 obtained from the Jembrana Regency Health Office and the Investment and One-Stop Integrated Service Office (PMPTSP), there were 462 midwifery practices recorded in Jembrana Regency. After validation using Google Street View and direct field verification, four midwifery practices were not found at the locations corresponding to the addresses recorded by the Health Office and the PMPTSP Office of Jembrana Regency. Therefore, the total number of midwifery practices included in this study was 458, located across 91 locations.

Based on the map in [Figure 1](#), it can be seen that midwifery practices are distributed across all sub-districts in Jembrana Regency. Midwifery practices were distributed across all sub-districts in Jembrana Regency. However, the locations of the practices tended to cluster in the central area, particularly in Negara and Jembrana Sub-districts, which had higher population densities compared with other sub-districts. In addition, there were still several villages that did not have any midwifery practices, namely Belimbing Sari Village, Tegal Badeng Barat Village, Budeng Village, Sangkaragung Village, Pergung Village, Yeh Embang Kauh Village, Yeh Embang Kangin Village, Asahduren Village, Manggis Sari Village, and Pangyangan Village. This condition indicates that disparities in the distribution of midwifery services still exist in Jembrana Regency, which may limit community access to maternal healthcare services, particularly for populations living in rural areas.

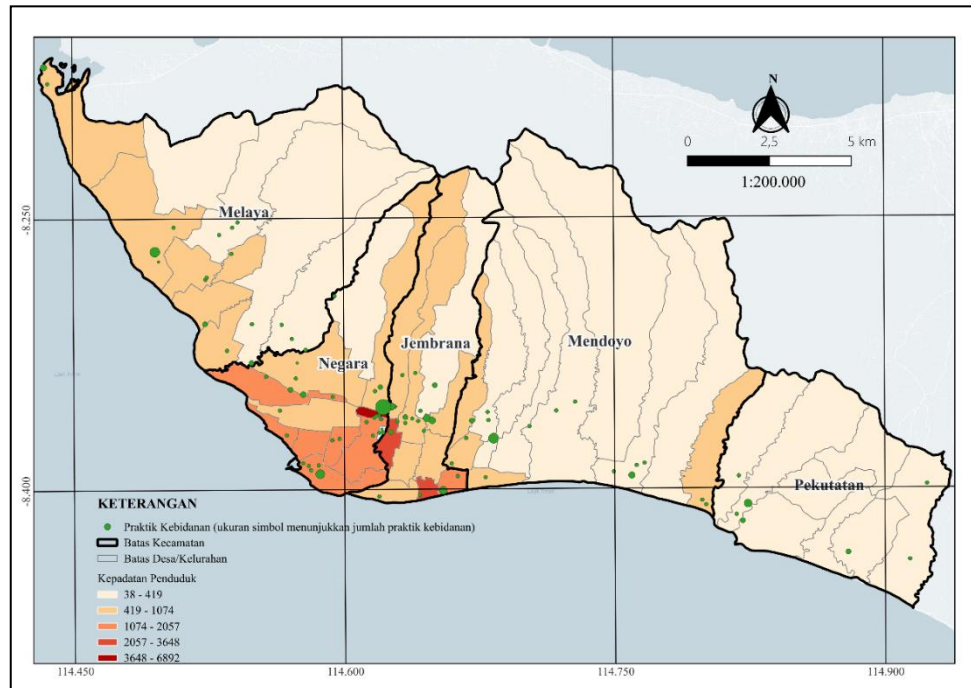


Figure 1. Map of the Distribution of Midwifery Practice Locations in Jembrana Regency in 2025

To provide an overview in the context of the need for midwifery services, the distribution of midwifery practice locations was further examined based on the number of Couples of Reproductive Age (PUS) in each village in Jembrana Regency. The PUS indicator was used as a proxy for the target population for midwifery services.

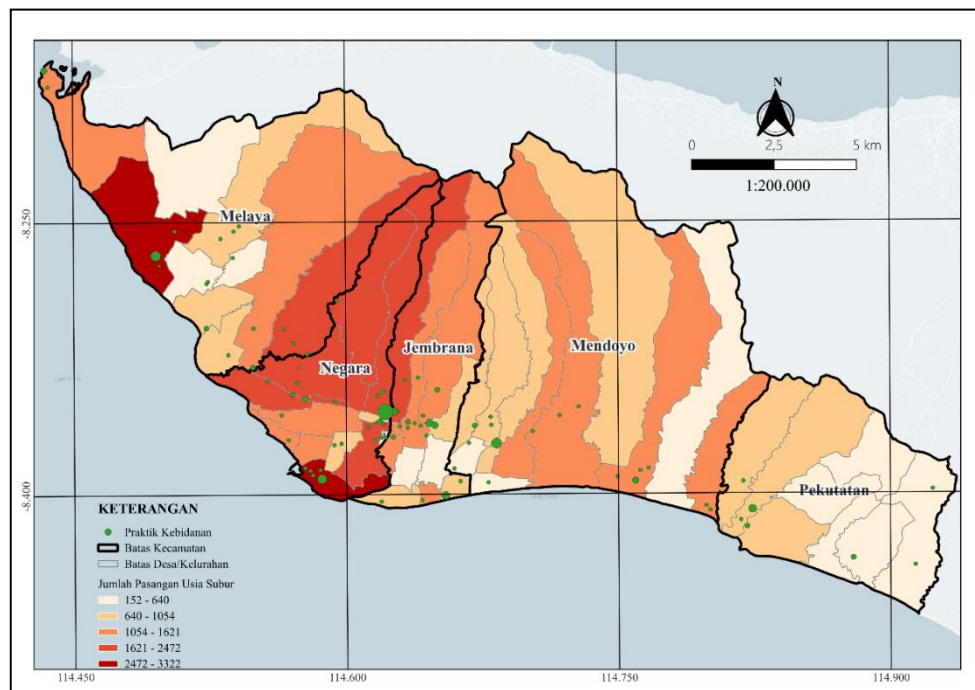


Figure 2. Map of the Distribution of Midwifery Practice Locations Based on the Number of Couples of Reproductive Age (PUS) in Jembrana Regency in 2025

Based on the map in [Figure 2](#), areas with a higher number of Couples of Reproductive Age (PUS) tend to have a greater number of midwifery practices. A high number of PUS can be observed in villages located in Negara, Jembrana, and Melaya Sub-districts, where midwifery practice locations also tend to be more numerous.

Distribution Pattern of Midwifery Practices

The distribution pattern of midwifery practices was analyzed using nearest neighbor analysis, which resulted in three categories of distribution patterns: clustered, random, and dispersed, determined based on the z-score value.

Table 1. Distribution Pattern of Midwifery Practices

Region	Z-Score	Nearest Neighbor Index Value	Distribution Pattern	Nearest Distance Between Midwifery Practices
Jembrana Regency	-10,1570	0,4434	Clustered	95,40 meters
Melaya Sub-district	-3,7988	0,5320	Clustered	151,97 meters
Negara Sub-district	-1,3112	0,8749	Clustered	95,40 meters
Jembrana Sub-district	0,7862	1,0919	Random	198,31 meters
Mendoyo Sub-district	-1,3502	0,8236	Clustered	364 meters
Pekutatan Sub-district	2,9848	1,5898	Dispersed	543,14 meters

Based on [Table 1](#), the results indicate that the distribution pattern of midwifery practices in Jembrana Regency tends to be clustered, with a z-score value < -1 and a nearest neighbor index ratio < 1 . This indicates that the locations of midwifery practices in Jembrana Regency are not evenly distributed and tend to form clusters. Based on the distance between midwifery practices in Jembrana Regency, the shortest distance between practices is 95.40 meters. Meanwhile, the largest nearest-neighbor distance is found in Pekutatan Sub-district, with a distance of 543,14 meters.

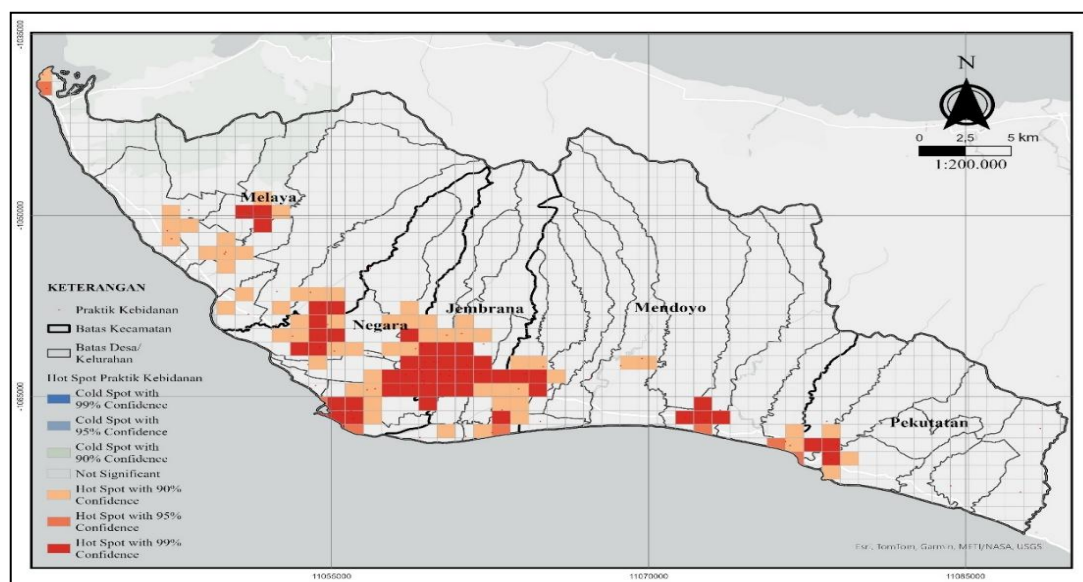


Figure 3. Hot Spot Map of Midwifery Practices in Jembrana Regency in 2025

Based on the map in [Figure 3](#), within an area of 1 km² or 1,000 meters × 1,000 meters, the hot spot analysis identified several areas classified as hot spots at confidence levels of 90%, 95%, and 99%. These findings indicate that midwifery practices were located in close proximity to one another, resulting in spatial clustering patterns. Areas with hot spots at the 99% confidence level were predominantly identified in Jembrana and Negara Sub-districts. These results demonstrate statistically significant clustering of midwifery practices in certain areas of Jembrana Regency, where Negara and Jembrana Sub-districts had higher concentrations of midwifery practices compared with other areas.

Geographical Accessibility

Geographical accessibility was assessed based on the nearest distance between midwifery practices and the centers of villages/urban villages. Jembrana Regency has 51 villages/urban villages, and the village/urban village office was used as the village center point, as shown in [Figure 4](#).

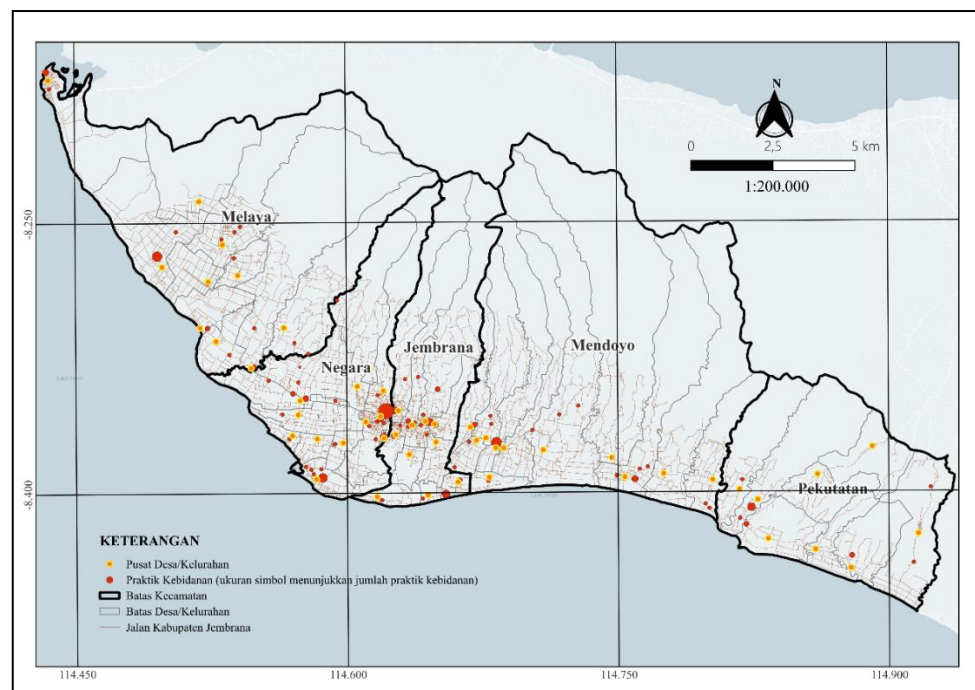


Figure 4. Map of the Distribution of Midwifery Practices and Village/Urban Village Centers in Jembrana Regency in 2025

[Table 2](#) the average nearest distance between village/urban village centers and midwifery practices in Jembrana Regency is 894,25 meters. The shortest distance from a village/urban village center to the nearest midwifery practice is 32,50 meters, while the longest nearest distance is 4.518,98 meters.

The village with the shortest distance from the village center to the nearest midwifery practice is Dangin Tukadaya. In contrast, the longest distance from a

village center to the nearest midwifery practice occurs in Asahduren, which is located in Pekutatan Sub-district. Additionally, this village does not have a midwifery practice within its administrative area.

Table 2. Nearest Distance from Village/Urban Village Centers to Midwifery Practices in Jembrana Regency

Region	Nearest Distance Between Village/Urban Village Centers and Midwifery Practices		
	<i>Mean</i>	<i>Min</i>	<i>Max</i>
Jembrana Regency	894,25	32,50	4.518,98
Melaya Sub-district	780,21	50,61	2.850,95
Negara Sub-district	566,20	40,43	1.539,54
Jembrana Sub-district	462,52	32,50	1.966,58
Mendoyo Sub-district	876,70	272,66	1.727,72
Pekutatan Sub-district	2.092,64	610,13	4.518,98

Discussion

The findings showed that midwifery practices in Jembrana Regency tended to concentrate in urbanized areas, particularly in Negara and Jembrana Sub-districts. This pattern can be explained by differences in sub-district characteristics, as these areas function as the administrative, economic, and community activity centers of the regency, with higher population density, better accessibility, and more developed socio-economic conditions compared with other sub-districts.

From the perspective of service demand, sub-districts with higher numbers of Couples of Reproductive Age (PUS), such as Negara, Jembrana, and Melaya, also tended to have more midwifery practices. This suggests that the distribution of services generally follows population healthcare needs, where larger populations and higher numbers of reproductive-age couples generate greater demand for antenatal care, delivery services, and reproductive health services. In such contexts, urban areas also tend to offer more favorable conditions for service utilization and practice sustainability compared to rural areas. These findings are consistent with Laksono and Wulandari (2020), who reported higher utilization of childbirth services in urban areas in Indonesia [14], as well as studies in the Special Region of Yogyakarta, which highlight that the concentration of health facilities in urban areas is driven by population density, service demand, economic considerations, and regional accessibility [15].

This spatial tendency is further confirmed by the nearest neighbor analysis, which shows a clustered distribution pattern of midwifery practices in Jembrana Regency. The clustering reflects the concentration of practices in areas with specific characteristics, particularly in Negara Sub-district as the administrative and population center with higher healthcare demand, while Melaya and Mendoyo Sub-districts also function as strategic locations due to their relatively good accessibility and proximity to urban areas. These results are supported by hot spot analysis, which

identifies high-confidence (99%) clusters predominantly in Negara and Jembrana Sub-districts, reinforcing the existence of significant spatial concentration. Consistently, previous research by Sadali et al. also shows that health facility distribution tends to concentrate in areas with larger populations and better accessibility due to higher healthcare demand [15].

In terms of accessibility, geographical accessibility in this study – measured by travel distance between midwifery practices and village centers – reveals disparities between urban and rural populations. Urban communities generally have shorter travel distances to midwifery services, while rural populations must travel farther, indicating unequal spatial access to care. This condition has the potential to create barriers to healthcare utilization, particularly for pregnant women, as longer geographical distances have been shown to reduce attendance at antenatal care services [16].

Overall, although the distribution of midwifery practices reflects community healthcare needs, equitable access remains suboptimal, as several villages still lack midwifery services. This unequal distribution contributes to delays in seeking healthcare services, which may ultimately increase maternal and infant morbidity and mortality, given the crucial role of midwifery services in preventing complications [17]. Therefore, spatial equity should also be considered in the planning of midwifery service distribution. Planning should integrate both demand-based and equity-based approaches to ensure fair access across all areas.

4. Conclusion

A total of 458 midwifery practices were included in this study in Jembrana Regency, distributed across 91 practice locations. The distribution pattern of midwifery practices in Jembrana Regency shows a clustered pattern, as indicated by a z-score value < -1 and a nearest neighbor index ratio (r) < 1 . Midwifery practices in Jembrana Regency also demonstrate the presence of hot spots, with areas of 99% confidence level hot spots predominantly located in Jembrana and Negara Sub-districts. Based on the distance between midwifery practices in Jembrana Regency, the shortest distance between practices is 95.40 meters, which is located in Negara Sub-district.

The geographical accessibility of midwifery practices in Jembrana Regency was assessed based on the distance from village centers to the nearest midwifery practice. The findings indicate disparities in travel distance between urban and rural communities. The average distance from village centers to the nearest midwifery practice in Jembrana Regency is 894.25 meters, with the shortest distance of 32,50 meters found in Dangin Tukadaya, which is categorized as an urban area. Meanwhile, the longest distance of 4,518.98 meters occurs in Asahduren, which is categorized as a rural area.

For future researchers with similar topics, it is recommended to examine the accessibility of midwifery practices using additional indicators, such as operational hours of the practices and transportation or accommodation factors. Furthermore, population migration data and residential land area may be considered to obtain population size and density data that better reflect actual field conditions. In addition, the Jembrana Regency Health Office is encouraged to conduct data-driven planning for the equitable distribution of midwifery services, taking into account the ratio of midwifery practices to population size as well as mapping results identifying areas that currently lack midwifery practices.

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