



Spatial analysis of health facilities in Mamuju City, West Sulawesi[☆]



Asbi Samli^{a,*}, Veni Hadju^b, Andang Suryana Soma^c

^a Regional Planning and Development Department, Graduated School, Hasanuddin University, Makassar, Indonesia

^b Faculty of Public Health, Hasanuddin University, Indonesia

^c Faculty of Forestry, Hasanuddin University, Indonesia

Received 8 November 2019; accepted 2 June 2020

KEYWORDS

Health facilities;
Accessibility;
Overlay analysis;
Buffer analysis

Abstract

Objective: This study was to look at accessibility health facilities and radius services health facilities in Mamuju City.

Methods: Data collected by survey method with the help of GPS devices and use two analyses, overlay analysis and buffer analysis.

Results: Based on the results of preparations made in the QGIS application with the overlay method, it was found that in general, the health facilities in Mamuju City are close to residential areas and road networks. The buffer results show that health facilities in Mamuju City, in general, have served the surrounding area. Tadui health center is in the most distant condition from the three hospitals.

Conclusion: From the results of the analysis that related to the analysis of accessibility and radius of service of health facilities in the Mamuju City, it can conclude that the distribution of health facilities in the Mamuju City is quite good and in accordance the conditions of the community. However, there are still a number of things that need to address. There are still areas that have not been facilitated properly.

© 2020 Elsevier España, S.L.U. All rights reserved.

Introduction

The current problem faced by developing countries is the increase in population over time. But this was not followed by an increase in the number of health facilities and adequate health workers.¹ Besides the accessibility factor becomes a major challenge in achieving health goals.² Accessibility to health care facilities is one of the main

[☆] Peer-review under responsibility of the scientific committee of the 4th International Conference Hospital Administration (ICHA4). Full-text and the content of it is under responsibility of authors of the article.

* Corresponding author.

E-mail addresses: asbhe06@gmail.com, pmc@agri.unhas.ac.id (A. Samli).

indicators of development. There are still many gaps in access to health facilities. Accessibility is the ease of someone in obtaining an object or service. One of the serious problems in Indonesia is the issue of accessibility to health service centers. In general, the reason for the difficulty of accessibility is due to the lack of transportation facilities and infrastructure and geographical factors of the region, especially in rural areas with mountainous or archipelago landscapes. Another problem is the distribution of settlements that are not located within the radius of service facilities, thus affecting the performance of services in the health sector.

Since the formation of the West Sulawesi Province in 2004 into its own autonomous region, Mamuju Regency designated as the provincial capital. Its establishment as the capital significant influence on the dynamics of development in Mamuju City. One of them is the swift flow of population migration and the number of births. Therefore, the Mamuju Regency Government needs to expect early on in terms of improving health services.

The purpose of this study was to look at accessibility and radius services health facilities in Mamuju City, West Sulawesi. This research uses GIS applications in analyzing the problems. GIS is now very useful as a tool to analyze the risk identification of health facility services in spatial aspects¹ and used to take into account many factors related to locations.² So, with that, it will be a reference for Mamuju Regency Government in formulating strategic policies related to health.

Method

This study took place in the City of Mamuju, West Sulawesi Province, Indonesia. Data collected by survey method with the help of GPS (*Global Positioning System*) devices with plotting health facilities in Mamuju City and then processing them in the QGIS 3.10 Coruna application with more data in the form of vector maps. The analysis used in this study are:

1. **Overlay analysis** Map overlay analysis is a method of overlapping or stacking maps with the same scale, containing different information or combining several thematic maps with a specific purpose. Maps that will overlap are land use maps and road network maps.³ Overlay analysis used to see the relationship between land use maps,

road network maps and points of hospitals and health centers.⁴ Data obtained from the Local Development Planning Agency of West Sulawesi Province Government.

2. **Buffer analysis** Buffering, which is an analysis that will produce a buffer that can form a circle or polygon that surrounds an object as its center, so we can find out how many limits of the object and its area.⁵ Placement of these facilities will take into account the radius of the service area related to the basic needs of the facilities that must meet to serve a particular area.⁶ This method will help Planners to know whether an area covered by a health facility or not. Placement of facilities based on the Indonesian national standard (SNI) 03-1733-2004 concerning the procedure for planning a residential environment in urban areas can see in Table 1.

Results

Based on the results of preparations made in the QGIS application with the overlay method, it was found that in general, the health facilities in Mamuju City are close to residential areas and road networks. For more details can be seen in Fig. 1.

The Rimuku health center closest to the Local General Hospital around 393.93m and the farthest away is The Tadui Health Center around 10941.66m. The Rimuku Health Center closest to Mitra Manakarra hospital is around 448.26m and the farthest is the Tadui health Center around 11184.98m. The Karema Health Center closest to the Regional hospital is around 1989.35m and the farthest is tadui health center around 14000.43m The distance between the Health Centre and the hospital can see in Table 2 and Fig. 2.

The buffer results show that health facilities in Mamuju City, in general, have served the surrounding area but some areas that are not covered by health facilities, Especially in the Rangas and Sumare area. For more details can be seen in Fig. 3.

Discussion

Infrastructure development is a major supporter of the social and economic system, therefore every design of each infrastructure system and its entirety must carry out in the context of integration and overall. Infrastructure systems

Table 1 Placement of Health facilities based on the Indonesian national standard (SNI) 03-1733-2004 Concerning the procedure for planning a residential environment in urban areas.

Type of facilities	Achievement radius	Location and settlement
Maternal and Child Health Services	500 m	In the middle, the neighboring group does not cross the highway
Citizens Treatment Center	1000 m	In the middle, the neighboring group does not cross the highway
Maternity Clinic	4000 m	Can be reached by public transportation
Supporting Health Centers and Environmental Medicine Centers	1500 m	Can be reached by public transportation
Health Center and Medical Center	3000 m	Can be reached by public transportation
Pharmacy/Home Medicine	1500 m	Can be reached by public transportation

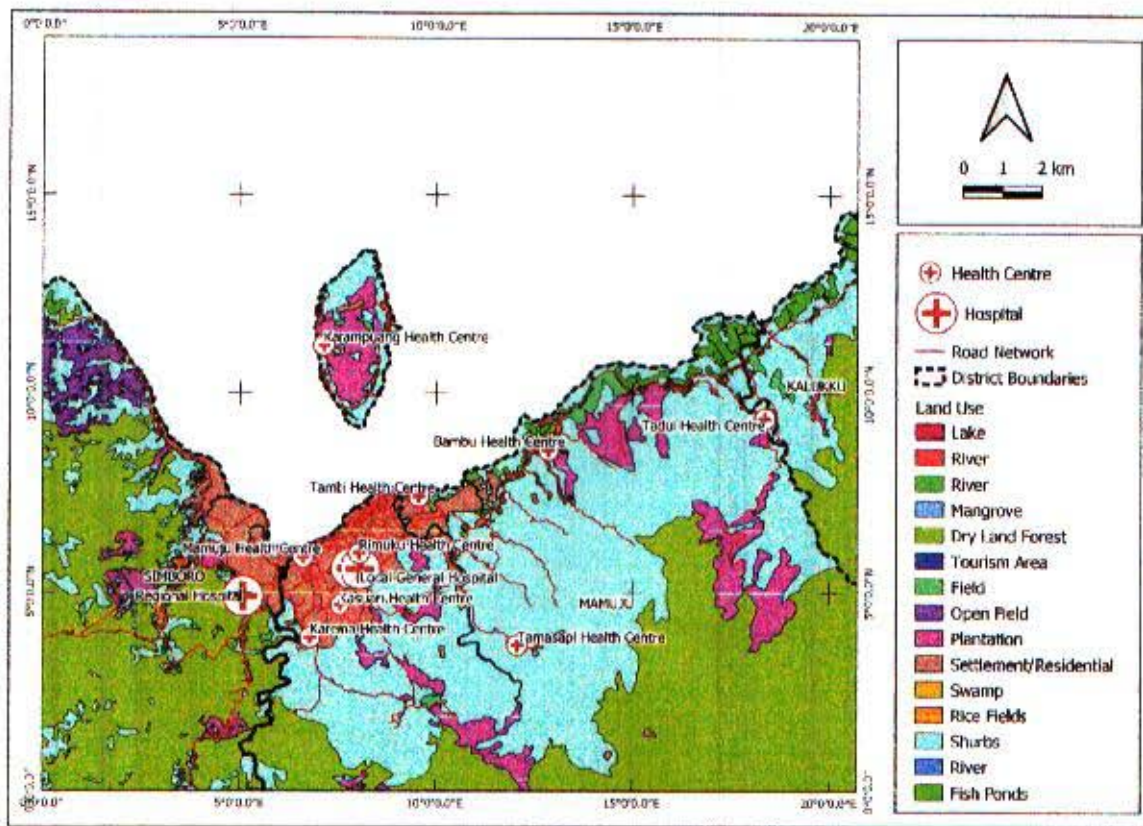


Figure 1 Land use maps and road network maps overlay.

Table 2 Distance matrix health center and hospitals in Mamuju city.

	Local General Hospital (m)	Mitra Manakarra Hospital (m)	Regional Hospital (m)
Tadui Health	10,941.66	11,184.98	14,000.43
Mamuju Health Centre	3938.31	3937.61	7308.26
Karema Health Centre	2168.78	2032.32	1989.35
Rimuku Health Centre	393.93	448.26	3164.82
Kasuari Health Centre	1049.68	956.23	2476.66
Tamasapi Health Centre	4433.34	4677.37	7099.73
Bambu Health Centre	5628.52	5847.00	8596.52
Karampuang Health Centre	5678.69	5626.34	6600.38
Tambi Health Centre	2358.75	2523.26	5144.03

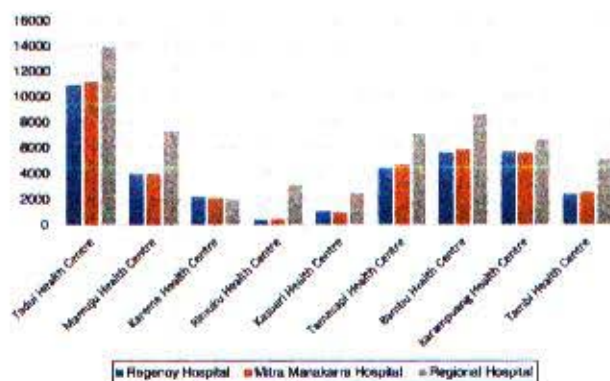


Figure 2 Distance graph health center and hospitals in Mamuju city.

that divided into various sub-systems cause the infrastructure system to become complex. Stages starting from the study, planning, development, and use as well as maintenance are processes that must carry out in an integrated and comprehensive way. The infrastructure system is a process with the involvement of various aspects, interdisciplinary, and multi-sectoral. In general, regional infrastructure is divided into two important scopes, namely facilities and utilities. The facility itself cannot run if there is no utility. Facilities talk about the provision, range of services to an area. The aspect examined is the analysis of accessibility and radius of affordability of health facilities. Geographical Information System (GIS) is the right step in analyzing accessibility and analyzing areas where the geographical area reaches by health services. Because of Geographic

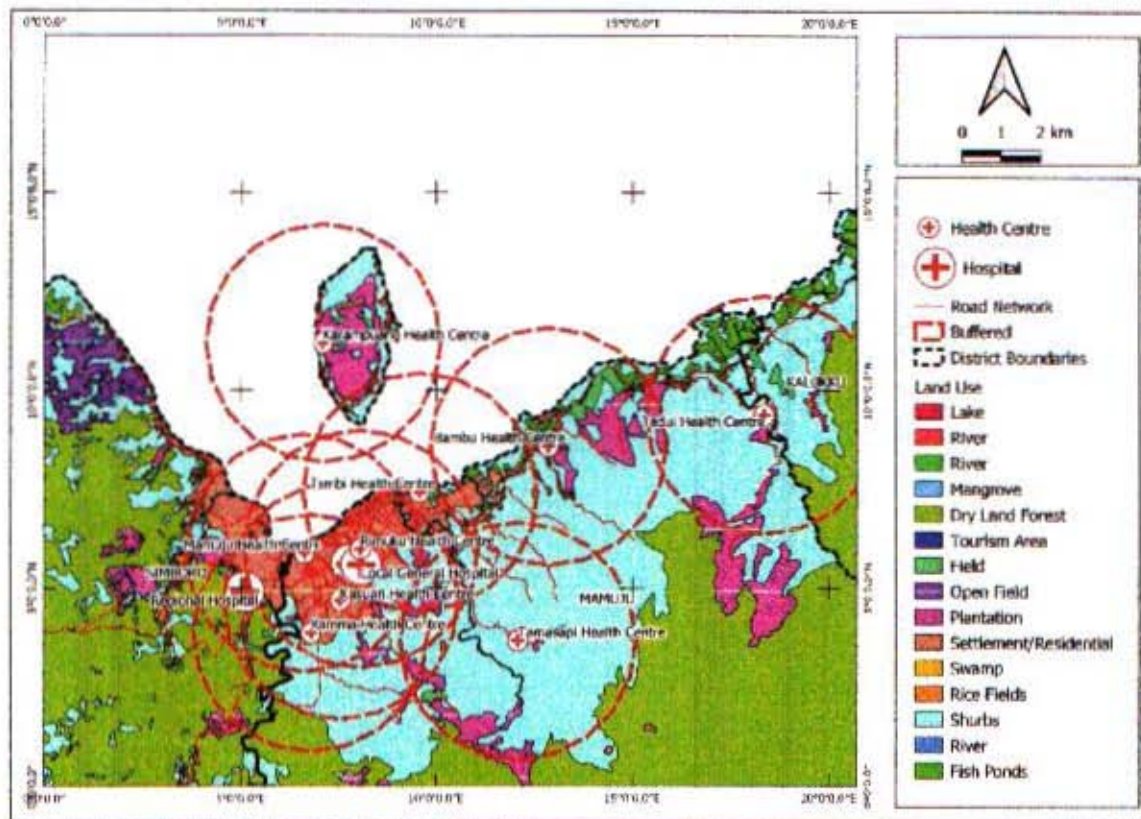


Figure 3 Service range of health facilities services.

Information Systems (GIS) ability to spatial analysis (spatial analysis) and time (temporal analysis) so that the technology is often used in the spatial planning process.

The distance matrix shows that Tadui health center is in the most distant condition from the three hospitals, which is 10,941 km from the regional hospital, 11,184 km from Mitra Manakarra hospital and 14,000 Km from the Regional Hospital. If we look at the health center distance map with the road network close enough so that accessibility can be said to still quite smooth even though it takes enough time. Therefore, for this condition the Mamuju Government needs to prepare adequate vehicles for transportation of patients, as well as the road network must stay in good condition. The buffered map also shows that there are still some areas that are not covered by health facilities. Therefore, the Mamuju district government needs to expect these problems, such as preparing health service vehicles or creating new health facilities

Conclusion

From the results of the analysis that related to the analysis of accessibility and radius of service of health facilities in the Mamuju City, it can conclude that the distribution of health facilities in the Mamuju City is quite good and in accordance the conditions of the community. However, still a number of things that need to address. There are still areas that have not been facilitated properly.

Acknowledgments

Many thanks to all those who have helped me, especially to the Government of West Sulawesi Province who has helped a lot in the availability of data and does not forget to my supervisor who has taken the time to give insight and knowledge. And also, I say thanks to the QJS 3.10 Coruna team.

Conflict of interest

The authors declare no conflict of interest.

References

1. Manortey S, Acheampong GK. A spatial perspective to the distribution of healthcare facilities and health personnel in the Eastern Region of Ghana. *OALib*. 2016;03:1–13, <http://dx.doi.org/10.4236/oalib.1102956>.
2. Lawal O, Anyiam FE. Modelling geographic accessibility to Primary Health Care Facilities: combining open data and geospatial analysis. *Geo-Spatial Inf Sci*. 2019;22:174–84, <http://dx.doi.org/10.1080/10095020.2019.1645508>.
3. Mansour S. Spatial analysis of public health facilities in Riyadh Governorate Saudi Arabia: a GIS-based study to assess geographic variations of service provision and accessibility. *Geo-Spatial Inf Sci*. 2016;19:26–38, <http://dx.doi.org/10.1080/10095020.2016.1151205>.
4. Sharma AK. Role of GIS in health management information system and medical plan: a case study of Gangtok area, Sikkim

- India. *Int J Environ Geoinform*. 2015;2:16–24, <http://dx.doi.org/10.1089/ijgeoin.2014.0019>.
5. Reshadat S, Saedi S, Zangeneh A, Ghasemi SR, Gilan NR, Karbasi A, et al. Spatial accessibility of the population to urban health centres in Kermanshah Islamic Republic of Iran: a geographic information systems analysis. *East Mediterr Heal J*. 2015;21:389–95, <http://dx.doi.org/10.26719/2015.21.6.389>.
6. Fadahunsi JT, Kufonyi O, Babatimhin OI. Spatial analysis of distribution patterns of healthcare facilities in Osun State, Nigeria. *Univers J Public Heal*. 2017;5:331–44. doi:10.1189/ujph.2017.050701.
7. Sedenu A, Muibi K, Alaga A, Ajilkeye O, Ogbole J, Kappo A, et al. Spatial analysis of the distribution pattern of primary healthcare facilities in ile – ife metropolis using geographic information system. *J Sci Res Rep*. 2016;10:1–15, <http://dx.doi.org/10.97349/jrr/2016/101159>.
8. Zhou G, Huang S, Wang H, Zhang R, Wang Q, Sha H, et al. A buffer analysis based on co-location algorithm. *Int Arch Photogramm Remote Sens Spat Inf Sci – ISPRS Arch*. 2018;42:2487–90, <http://dx.doi.org/10.5194/isprs-archives-42-3-2487-2018>.