ORIGINAL ARTICLE

Geospatial Analysis of Ayurveda Healthcare Facilities in Kathmandu Valley, Nepal

Nirmal Bhusal[1], Mithilesh Kumar Sah[2*], Munkarna Thapa[3], Santosh Kumar Thakur[4], Rupendra Maharjan[5], Birat Shrestha[6] Bikas Raj Ghimire[7], Pradeep KC[8], Vasudev Upadhaya[9]

[1]Assistant Professor & Head, Department of Panchakarma, Ayurveda Campus, Institute of Medicine, Tribhuvan University, Kathmandu, Nepal, [2]Assistant Professor & Head, Department of Sanskrit Samhita Siddhanta, Ayurveda Campus, Institute of Medicine, Tribhuvan University, Kathmandu, Nepal, [3]Consultant Ayurveda, Department of Ayurveda and Alternative Medicine, Ministry of Health and Population, Kathmandu, Nepal, [4]Executive Director, National Ayurveda Research and Training Centre, Ministry of Health and Population, Kirtipur, Kathmandu, Nepal, [5]Postgraduate Scholar - Master of Science in Geospatial Intelligence, Curtin University, Perth, Australia, [6]Engineering Geologist, Explorer Geophysical Consultant Pvt. ltd., Kathmandu, Nepal, [7]Assistant Professor, Department of Kaya Chikitsa, Ayurveda Campus, Institute of Medicine, Tribhuvan University, Kathmandu, Nepal, [8]Director, Simha Darbar Vaidyakhana Bikas Samiti, Ministry of Health and Population, Anamnagar, Kathmandu, Nepal, [9]Director, Central Ayurveda Hospital, Ministry of Health and Population, Naradevi, Kathmandu, Nepal.

*Corresponding author

Dr. Mithilesh Kumar Sah
Assistant Professor & Head
Department of Sanskrit Samhita Siddhanta,
Ayurveda Campus, Institute of Medicine,
Tribhuvan University, Kirtipur
Email: dr.mithilesh11@gmail.com

ABSTRACT

Background: Ayurveda plays a vital role in Nepal's health care delivery system. Despite its cultural importance, the geographical accessibility and distribution of Ayurveda health centers remain underexplored. This study aimed to map and analyze the spatial distribution of Ayurveda health centers in Kathmandu Valley using Geographic Information Systems (GIS) and mobile-based data collection tools.

Materials and Methods: The mixed-methods geospatial research was conducted in three districts of Kathmandu Valley- Kathmandu, Lalitpur, and Bhaktapur. Data were collected from 267 Ayurveda health centers by trained surveyors using the SW-Map mobile application, supplemented by hardcopy forms. The collected geospatial data were processed using ArcGIS 10.7.1 to analyze distribution and accessibility patterns. Visualization was performed on Google Earth, with outputs generated in KML format.

Results and Discussion: A total of 267 clinics were identified: 221 (82.8%) in Kathmandu, 20 (7.5%) in Lalitpur, and 26 (9.7%) in Bhaktapur. Spatial analysis showed a dense concentration in urban cores, with Kathmandu Metropolitan exhibiting the highest clustering. Accessibility analysis indicated that urban residents generally had a clinic within 2 km, while rural and peripheral populations often had to travel over 5 km. Services offered included Panchakarma, herbal medicine dispensing, yoga, massage, and diagnostics.

Conclusion: GIS proved effective in mapping Ayurveda health centers and identifying accessibility gaps. The study highlights inequitable distribution, with underserved rural and peri-urban populations facing limited access. Findings can inform health policymakers to expand Ayurveda services strategically.

Keywords: Ayurveda, GIS, Kathmandu Valley, healthcare accessibility, geospatial mapping, traditional medicine.

Bhusal N et al. JAC. Oct 2025;6(1):12-17

ORIGINAL ARTICLE

INTRODUCTION

Ayurveda, one of the world's oldest systems of medicine,[1] has been practiced in South Asia for over 3,500 years.[2] In Nepal, Ayurveda is recognized as an integral part of the national health care system, with government-run Ayurveda hospitals, dispensaries, and private clinics contributing to health service delivery.[3] The World Health Organization (WHO) estimates that nearly 80% of populations in some developing countries depend on traditional medicine for their basic health needs.[4] In Nepal, Ayurveda enjoys high levels of cultural acceptance and has been embedded in community-level health practices and is supported by the national healthcare system [5,6] And it is estimated that more than 75 percent of the population in the country uses traditional medicine.[7]

Geographic distribution of facilities strongly influences whether populations can benefit from available health services.[8] Studies from multiple countries show that spatial inequalities in healthcare access exacerbate existing socioeconomic disparities.[9,10] In this context, assessing where Ayurveda health centers are located, and how populations can access them, becomes essential for informed policymaking[11] as GIS have emerged as indispensable tools for public health planning.[12]

In South Asia, mainly in India, several GIS-based studies have mapped health facilities.[12] Unequal spatial distribution of private health clinics, with urban concentration leading to rural under-service. Iranian studies demonstrated marked accessibility gaps in rural provinces using GIS-based spatial accessibility measures.[13] Despite this progress, no studies have systematically mapped Ayurveda health facilities, particularly in Kathmandu Valley. The Kathmandu Valley with the capital city of Nepal provides an ideal place study for such mapping in perspective of Ayurveda.[14] It is Nepal's most urbanized region, hosting the capital city and over three million people with three districts.[15] While the valley has numerous private and government Ayurveda facilities, no comprehensive geospatial documentation exists. Previous reports from the Department of Ayurveda and Alternative medicine provide only aggregate numbers, without spatial or accessibility analysis.[16] Despite its cultural and historical importance, information about the spatial distribution and accessibility of Ayurveda health centers remains limited. To address this gap, this study focuses on mapping and analyzing Ayurveda clinics in Kathmandu Valley using geospatial technologies. The objectives were to identify their distribution patterns, assess accessibility, provide spatial distribution of Ayurveda health centers in Kathmandu Valley, assess accessibility patterns across urban and rural areas and analyze services offered by Ayurveda facilities and discuss implications for healthcare equity. By integrating mobile-based mapping (SW-Maps) with GIS analysis (ArcGIS and Google Earth), this study demonstrates a replicable model for documenting and analyzing traditional medicine services.

MATERIAL AND METHODS

Research Type: The study is mixed-methods geospatial research, specifically within the domain of Ayurveda health service geography research.

Study Area: The study was carried out in Kathmandu Valley which consists of three districts—Kathmandu, Lalitpur, and Bhaktapur covering 665 square kilometers and is Nepal's political and economic hub, with high urbanization and rapid population growth where health services are concentrated in Kathmandu Metropolitan City, while peri-urban and rural wards of Bhaktapur and Lalitpur face relative scarcity of facilities.

Data Collection: A team of 10 trained surveyors, with backgrounds in Ayurveda, collected data between April and August 2024. Clinics were identified through official registries and field visits. Each clinic was geotagged using SW-Maps, a mobile GIS application capable of recording GPS coordinates, capturing photographs, and storing attribute data. The collected data included: Clinic name, address and municipality, GPS coordinates (latitude/longitude), services offered (treatments, pharmacy, diagnostics, yoga/massage), Photographic documentation and contact details supplementary hardcopy forms ensured reliability and captured additional service-related information.

Tools and Software

SW-Maps (mobile GIS): Enabled field data collection and geotagging.[17] The SW-Map mobile application was used to record clinic names, addresses, contact details, and geotagged photographs. Hardcopy forms supplemented the digital data to capture additional details of clinic. SW Maps is a GIS and mobile mapping app for collecting, presenting and sharing geographic information.

ArcGIS 10.7.1 (Esri): ArcGIS is a family of client, server and online geographic information system (GIS) software developed and maintained by Esri.[18] ArcGIS 10.7.1 was utilized in the present study to merge the data from SW Maps and the collected survey data of respective Ayurveda clinics. It was used for data cleaning, integration, and spatial analysis. Functions included clustering analysis, proximity (buffer) analysis, and thematic mapping.

Google Earth: Google Earth is a computer program that renders a 3D representation of Earth based primarily on satellite imagery. The program maps the Earth by superimposing satellite images, aerial photography, and GIS data onto a 3D globe, allowing users to see cities and landscapes from various angles. The final output of the present study is in the form of Keyhole Markup Language or KML with all the associated data (Photographic data, details of the Ayurveda health centres survey, latitude, and longitude) was used for 3D visualization of clinic locations. Final outputs were exported in KML (Keyhole Markup Language) format for interactive viewing.

Data Processing and Analysis: GPS-tagged data were imported into ArcGIS. District-wise and municipality-wise counts were generated. Spatial clustering was visualized. Proximity buffers (2 km, 5 km) were applied to identify underserved zones. Outputs were exported to Google Earth to provide interactive 3D representations.

Ethical Considerations: The study was conducted in compliance with ethical guidelines. The surveyors were given letters from Nepal Ayurveda Medical Council and participation was voluntary. Clinics consented to being mapped and included in the dataset.

RESULTS

Spatial Distribution

A total of 267 Ayurveda clinics were mapped across Kathmandu Valley. Their district-wise distribution is shown in Table 1.

Table 1: Distribution of Ayurveda clinics in Kathmandu Valley

District	Number of Clinics	Percentage (%)
Kathmandu	221	82.78
Lalitpur	20	7.49
Bhaktapur	26	9.74
Total	267	100

This confirms the finding of urban concentration, with Kathmandu district dominating (over 80% of clinics), likely due to its central metropolitan status. Bhaktapur and Lalitpur have smaller shares, indicating potential underserved areas in those districts' peripheries.

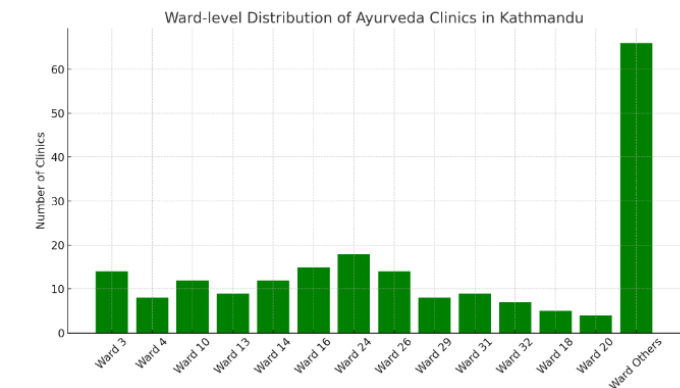Ward-level distribution for Ayurveda clinics:

Fig 1: Ward level distribution of Ayurveda clinics in Kathmandu

Out of 221 clinics in Kathmandu metropolitan, Ward 24 and Ward 16 stand out with the highest concentrations, while many other wards have scattered smaller numbers.

Out of 26 clinics in Bhaktapur, Clinics are evenly spread, but Wards 3, 4, 7, and 10 have slightly higher concentrations.

It details a geospatial study on the distribution of Ayurveda clinics in Kathmandu Valley, focusing on three districts: Kathmandu, Bhaktapur, and Lalitpur. The key findings highlight a total of 267 documented clinics, with a clear urban based in distribution-higher concentrations in central urban areas (especially Kathmandu city) and gaps in peripheral/rural zones.

Clinics primarily offer services like traditional treatments, herbal medicines, yoga, massage, therapy, diagnostics, curative care, and consultations.
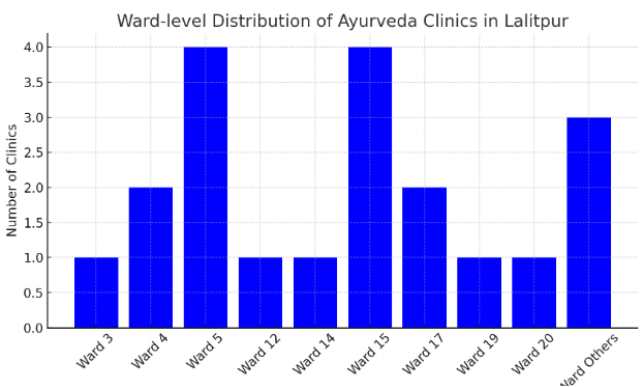

Fig 2: Ward level distribution of Ayurveda clinics in Lalitpur

Out of 20 clinics in Lalitpur, Ward 5 and Ward 15 show the most activity, with smaller counts distributed across other wards.
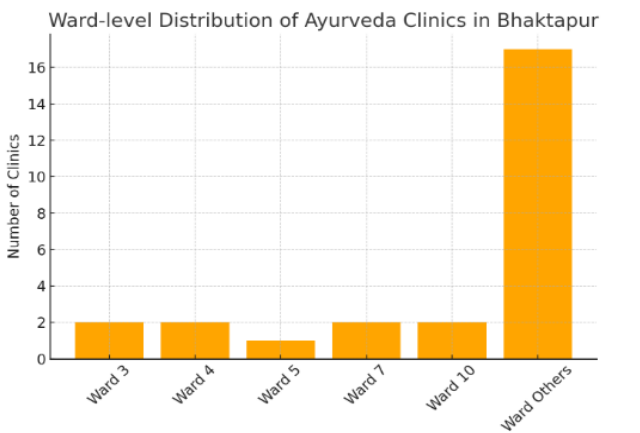

Fig 3: Ward level distribution of Ayurveda clinics in Bhaktapur

Accessibility is strong in urban areas (most residents within (most residents within <2 km of a clinic) but limited in rural parts (some areas lack clinics within 5 km), underscoring the need for better infrastructure.
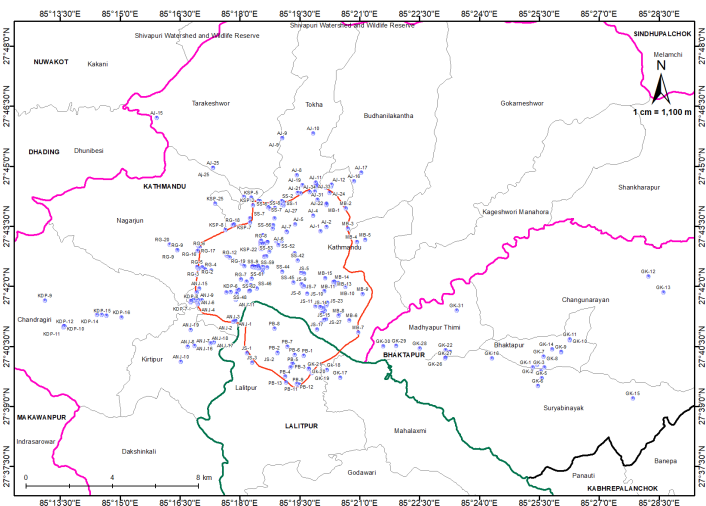

Fig 4: Distribution of Ayurveda service providing clinics and pharmacy

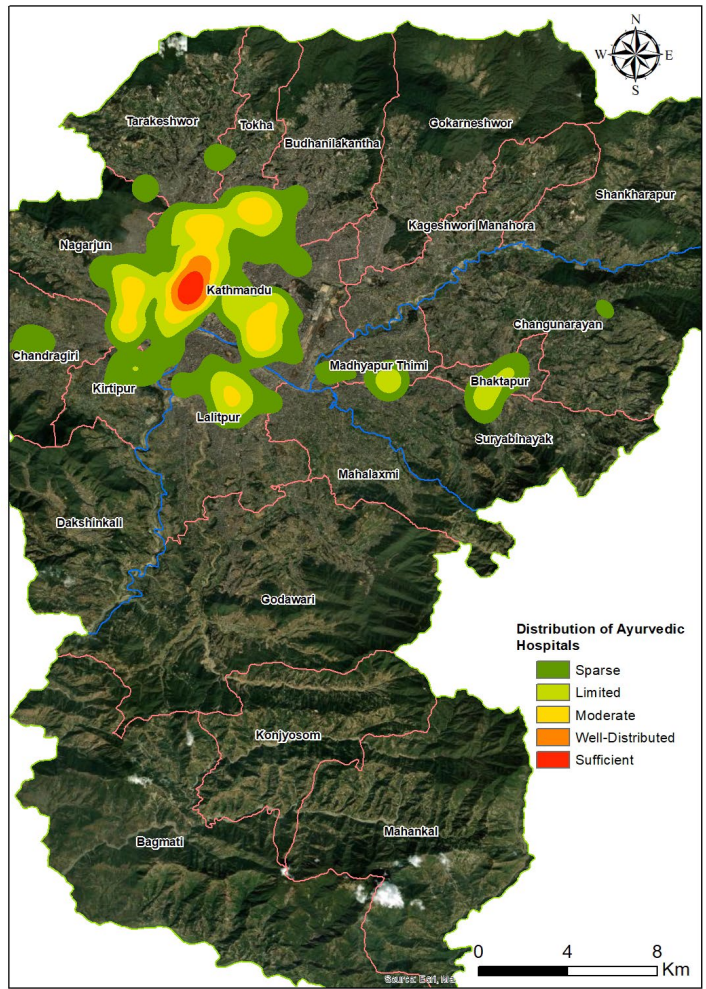*Bhusal N et al. JAC. Oct 2025;6(1):12-17*

ORIGINAL ARTICLE

Services Offered

Most centres provided a combination of services like Ayurveda pharmacy/dispensing of medicines was 78% while traditional therapies and Ayurveda consultation from 85% of centres. 52% centres claimed to provide Abhyanga/massage and yoga therapy while 40% centres had basic lab diagnostic services with them.

Table 2: Ayurveda services providing Centres/Clinics

Centres/ Clinics	Percent
Traditional therapies (Ayurvedic consultation, Therapies,)	85%
Ayurveda pharmacy/dispensing of medicines	78%
Massage and yoga therapy	52%
Diagnostic services (basic lab)	40%

The heterogeneity in services highlights both the strengths (diverse offerings) and gaps (limited diagnostics) of the current system.

Distribution of Ayurvedic Hospitals
- Sparse
- Limited
- Moderate
- Well-Distributed
- Sufficient

Category

Sparse: The area has a very low number of clinics relative to the population. Residents face significant challenges in accessing timely medical care, often requiring long travel times.

Limited: The number of clinics is insufficient for the population's needs, leading to potential overcrowding, long waiting times, and a lack of specialized services.

Moderate: The area has an adequate but not extensive number of clinics. While most basic healthcare needs can be met, there may be gaps in certain services or during peak demand.

Well-Distributed: Clinics are strategically located throughout the area, providing good accessibility for most residents. This distribution minimizes travel burden and helps ensure a consistent level of care.

Sufficient: The area has a high concentration and excellent distribution of clinics. Residents have easy, timely access to a full range of medical services, including both general and specialized care.

Accessibility Analysis

Proximity analysis revealed significant disparities. In urban areas, nearly 90% of households had access to an Ayurveda clinic within 2 km. In peri-urban and rural wards, residents often needed to travel 5–7 km to access services. Gaps were especially visible in the outer wards of Bhaktapur and Lalitpur.

DISCUSSION

The results underscore a stark urban–rural divide. With 83% of clinics located in Kathmandu, rural residents are underserved. This pattern mirrors global trends where private health facilities cluster in cities. For marginalized populations in Nepal, this could mean reduced access to culturally appropriate, affordable care. Accessibility gaps have significant equity implications. According to the inverse care law, populations with the greatest need often have the least access.[19] In Nepal, rural communities may rely more heavily on Ayurveda due to economic and cultural reasons yet face greater geographic barriers. Addressing these inequities is critical for ensuring Universal Health Coverage (UHC).

This study demonstrates the value of GIS in health service planning. By visualizing distribution and accessibility, policymakers can identify underserved municipalities for new clinic establishment, plan mobile Ayurveda outreach programs in rural zones and integrate Ayurveda clinics into broader primary healthcare networks.

Similar GIS-based approaches in India and Iran have influenced policy decisions regarding facility expansion and outreach. Ayurveda's recognition in Nepal's constitution underscores its role in national health. Strategically placing Ayurveda facilities aligns with Sustainable Development Goal 3 (Good Health and Well-being) and SDG 10 (Reduced Inequalities).[19] Expanding access could also reduce the burden on biomedical health centers by offering complementary care.

The study is the first kind of comprehensive GIS-based mapping of Ayurveda clinics in Kathmandu valley with use of mobile-based SW-Maps ensured accurate geotagging and integration of ArcGIS

ORIGINAL ARTICLE

Bhusal N et al. JAC. Oct 2025;6(1):12-17

and Google Earth provided both analytical and visual outputs.

The study is confined to Kathmandu Valley; findings cannot be generalized nationwide. Quality of care and patient utilization were not assessed. Rapid urban growth may soon alter distribution patterns. Future studies should expand nationwide, incorporate patient perspectives, and evaluate service quality.

CONCLUSION

This study successfully mapped and analyzed the spatial distribution of Ayurveda clinics in Kathmandu Valley using geospatial tools. The results highlight the need for strategic interventions to enhance healthcare accessibility in underserved areas. The integration of SW-Map, ArcGIS, and Google Earth offers a robust approach to healthcare data visualization and planning. Future research could extend this methodology to other regions or explore additional factors influencing accessibility. The findings show concentration in urban areas and significant accessibility gaps in rural and peri-urban wards. GIS proved to be an effective tool for healthcare planning and visualization.

Policy implications include suggestions for establishing new Ayurveda clinics in underserved rural areas, developing mobile Ayurveda health services for peri-urban populations and integrating Ayurveda into broader health system planning using GIS evidence. Expanding this methodology nationwide could strengthen Nepal's efforts toward equitable health care and universal health coverage.

REFERENCES

1. Mukherjee PK, Harwansh RK, Bahadur S, Banerjee S, Kar A, Chanda J, et al. Development of Ayurveda-tradition to trend. J Ethnopharmacol. 2017;197:10-24. DOI: 10.1016/j.jep.2016.09.024 PMID: 27633405

2. Kizhakkeveettil A, Parla J, Patwardhan K, Sharma A, Sharma S. History, present and prospect of Ayurveda. In: History, Present and Prospect of World Traditional Medicine. 2024. p. 1-72. DOI: 10.1142/9789811282171_0001

3. Shankar PR, Paudel R, Giri BR. Healing traditions in Nepal. J Am Assoc Integr Med. 2006.

4. World Health Organization. WHO global report on traditional and complementary medicine 2019. Geneva: World Health Organization; 2019 May 16.

5. Rössl ML. Entangled medical treatment: A network approach of traditional and biomedical health care providers in the Kathmandu Valley.

6. Subedi B. Advancing inclusive and democratic medical pluralism in Nepal. J Ayurveda Integr Med. 2024 Nov 1;15(6):100988. DOI: 10.1016/j.jaim.2024.100988

PMID: 39586157 PMCID: PMC11625320

7. Gautam A. A comprehensive analysis of the determinants influencing healthcare access: Individual, structural, and systemic factors and their policy implications.

8. Guagliardo MF. Spatial accessibility of primary care: concepts, methods and challenges. International journal of health geographics. 2004 Feb 26;3(1):3. DOI: 10.1186/1476-072X-3-3 PMID: 14987337 PMCID: PMC394340

9. Karamagi HC, Afriyie DO, Charif AB, Sy S, Kipruto H, Moyo T, Oyelade T, Droti B. Mapping inequalities in health service coverage in Africa: a scoping review. BMJ open. 2024 Nov 1;14(11):e082918. DOI: 10.1136/bmjopen-2023-082918 PMID: 39581717 PMCID: PMC11590813

10. Whitehead J, L. Pearson A, Lawrenson R, Atatoa-Carr P. How can the spatial equity of health services be defined and measured? A systematic review of spatial equity definitions and methods. Journal of health services research & policy. 2019 Oct;24(4):270-8. DOI: 10.1177/1355819619837292 PMID: 31460801

11. Rastogi S, Tiwari V, Jatav SP, Singh N, Verma S, Verma S, Sharma KG, Pandey P, Singh G. A survey of patients visiting an Ayurvedic teaching hospital for factors influencing the decision to choose ayurveda as a health care provider. Journal of Ayurveda and Integrative Medicine. 2023 Jan 1;14(1):100539. DOI: 10.1016/j.jaim.2021.100539 PMID: 35078695 PMCID: PMC10105234

12. Chandran A, Roy P. Applications of geographical information system and spatial analysis in Indian health research: a systematic review. BMC Health Services Research. 2024 Nov 21;24(1):1448. DOI: 10.1186/s12913-024-11837-9 PMID: 39574096 PMCID: PMC11580228

13. Reshadat S, Zangeneh A, Saeidi S, Teimouri R, Yigitcanlar T. Measures of spatial accessibility to health centers: investigating urban and rural disparities in Kermanshah, Iran. Journal of Public Health. 2019 Aug 1;27(4):519-29. DOI: 10.1007/s10389-018-0966-9

14. Thapa RB, Murayama Y, Ale S. Kathmandu. Cities. 2008 Feb 1;25(1):45-57. DOI: 10.1016/j.cities.2007.10.001

15. Singh RP, Dhakal J. Problems and prospects of urbanization in Kathmandu Valley. International Journal of Atharva. 2024 Mar 12;2(1):19-33. DOI: 10.3126/ija.v2i1.62821

16. Ministry of Health and Population. Nepal Health Sector Strategy Implementation Plan 2016-2021. Kathmandu: MoHP; 2016.

Bhusal N et al. JAC. Oct 2025;6(1):12-17

ORIGINAL ARTICLE

17. Ifediora CO. Assessing the use of smart phones-based apps, software and geographic information system (GIS) in real estate practice. International journal of development and economic sustainability. 2022;10(1):26-40. DOI: 10.37745/ijdes.13/vol10no1pp.26-40

18. Akhil P, Amritha Varsha P, Aparna T, Archa Lakshmi So. Comparative Assesment of Digital Elevation Models (Dems) in the Morphometric Analysis of Bharathapuzha River Basin (Doctoral dissertation).

19. Hart JT. The inverse care law. The lancet. 1971 Feb 27;297(7696):405-12. DOI: 10.1016/S0140-6736(71)92410-X PMID: 4100731