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APPLICATION OF GIS IN HEALTHCARE MANAGEMENT

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Abstract

Potential and capabilities of GIS in planning and decision-making is widely known as an experimental tool, but its existence in real-world application is yet to realize. GIS originated in the field of cartography and even at today it is mainly used as a tool for map production. Number of reasons can be brought forward for this shortcoming. Limited real-world applications could be a significant one among them. This paper describes an attempt to use GIS for healthcare system. A database was created for the region to apply the GIS technology with data gathered from various sources. Attempt was made to demonstrate the potential of GIS by using the database for identifying healthcare status, distribution of resources, recognizing deprived areas and locating areas for future investments based on accessibility and social status.

Key Words: Geographical information systems (GIS), healthcare

1. Introduction

GIS is becoming a vital tool in healthcare applications covering database management, planning, risk assessment, service area mapping, location identification etc. One of the reasons for this sudden surge of GIS usage in healthcare application is the spatial dependency of health related factors and limited resources for ever increasing demand. Distribution of services as well as health requirements need to be addressed in spatial domain in order to identify what is needed at individual location rather than looking into a problem as a whole.

Countries with least developed healthcare systems required international assistance to develop healthcare system including primary healthcare as well as health services. With continuous support from various international and non-government organizations, it is becoming important to review the distribution of international assistance in a given country and appropriateness of the assistance when compared with localities that should need special assistance. This present approach of assisting communities or special activity is considered more appropriate than assisting at the central level. Thus, it has become important to recognize local healthcare needs given the healthcare demands, social status and services that are available in the locality. This is where GIS could function as a very important tool.

2. Objectives

Objectives of the study were to evaluate the use of GIS for the following;

- Identify the discrepancy of service distribution in spatial domain.
- Screen areas with marginal services and recognize appropriate location for providing primary healthcare services.
- Suitability of health center mapping based on serviceable area, proximity to available facilities and population distribution.

3. Study area

In the present study, distribution of health services, physical accessibility and social background of each province and district was compared to identify most deprived areas. Subsequently, identified districts were investigated to recognize appropriate investment given social and accessibility condition of the area concerned.

Factors:

- Location of District hospital whether it is accessible for all the people living in the region.
- Availability of healthcare support during rainy season.
- Availability of electricity and piped water system in the district hospital.

4. Methodology:

Two constraints are involved:

- Services constraints:
- Accessibility
- Medical staff
- Facilities

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Social constraints:

- Clean water
- Latrine
- Electricity
- Literacy

After identifying the constraints we have following steps involved:

- ✓ Locate deprived areas
- ✓ Identify areas for primary health care investment
- ✓ Travel time
- ✓ Village population density
- ✓ Existing health facilities service

With the above methodology we can have potential locations for new health care center.

4.1 Locating remote districts

Initial step of the study was to observe data in national perspective using supply factors in terms of “Services constraints” and “Social constraints” for social factors.

The criterion to locate poor districts is as follows:

Travel time; if it is more than 6 hours from district hospital to provincial hospital both in dry and wet season, means poor physical accessibility. Patients in district hospital need to be transferred to the provincial hospital the case of emergency therefore good referral system should be related to the accessibility.

Medical staff; includes number of medical doctors, medical assistants and nurses. It was considered at least two from each category is needed for providing basic services.

Facilities; were considered available of X-ray machines and operation theatres. Medical facilities are essential when adequate medical staffs are provided.

Social constraint factors; are number of households which have not accessed to clean water, latrine, electricity and enough literacy level. 50% were used as the margin to separate living conditions good/poor in social factors.

Logical querying sequence of service constraints:

- Calculate travel time from district hospital (DH) to provincial hospital (PH) in dry and rainy season.
- If PH < 6hrs. Then go to Ph else calculate medical doctors (MD), medical assistants (MA) and nurses at DH.
- If MD! = 0 or MD >= 2 & MA >= 2 & nurse >=2.if it doesn't satisfy this rule then it is a poor DH. If it satisfies the above rule then check if X- Ray machines and operation theatres are available. If not, poor DH else a good DH.

Logical querying of social constraints:

Calculate % of household with clean water, without latrine, with electricity and literacy population.

- If % household with clean water < 50, % household without latrine > 50, % household without electricity > 50 then people are categorized as Poor Social Status.

4.2 Identification of the most suitable area for a new health centre

In the previous section, the method used to identify the most remote district with respect to accessibility was discussed and the criteria set for the same was defined. Having these criteria as the index for referring "poor" medical service areas, attempt was given to find the best location for investing or re-locating a health centre. It is considered that these health centres could provide primary healthcare services until improvement in infrastructure take place to provide medical services. In order to identify best location for a future investment for a health centre was carried out using GIS database developed. The criterion for the location selection was based on following conditions;

- Travel time
- Population density
- Existing serviceable area of health facilities

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Travel time from each village, which was represented by a point, was interpolated to create a surface representing time from any location in the district to the district hospital. Triangulated Irregular Network (TIN) method was used in generating time-surface. Further, time required to reach the district hospital from each location was grouped into 3 classes' viz. Longest, Moderate and Least with time ranges 24 hours or more, 12 to 24 hours and less than 12 hours, respectively. As with the time, population density was available for each village. Assuming a village is distributed in a spatial space with 2 kilometre radius, population density distribution was calculated. It was possible to obtain population distribution as a surface of population density. Subsequently, density surface was re-arranged into 3 classes; High (density more than 40 person/km²), Medium (10-40 person/ km²), and Low (less than 10 person/ km²). The third criterion was the serviceable area from available health facilities. It was considered that radius of six kilometres would be the serviceable area of the district hospital and this would be two kilometres for a health centre. As the above analysis generates three different raster data layers, analysis was carried out in raster analysis environment. Ranking of the above criterion was given a numerical value before combining them to a single value representing suitability for a health facility.

5. Result

- ✓ Finally the remote districts are identified where transportation is very poor and highly inaccessible.
- ✓ Next medical facilities that is available in the hospital. Poor facility hospitals are identified.
- ✓ The final step is identifying suitable areas for a new health centre.

6. Conclusion

It was found that GIS is a promising tool for examining health facility distribution, identifying deprived area as recognizing areas for future investment. It can be said that GIS is a better tool for handling spatial and descriptive data. Further, it was observed that GIS functionalities are ideal for evaluating with given constraints. Multi-source data can be analysed together with appropriate derivation of new

parameters. The above analysis could be further improved with incorporation of other relevant factors within GIS environment.

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