THE APPLICATION OF GIS FOR EFFECTIVE DISTRIBUTION OF THE EMERGENCY MEDICAL SERVICE AREA

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ABSTRACT:

The purpose of this paper is to take a closer look at an area having shorted emergence facilities and to determine optional candidate sites instead of vulnerable area by using GIS spatial analysis.
Newly determined new candidate is performed by concerning spatial efficiency and spatial equity for a public service. It was determined through using the analyzing of the physical accessibility measure, the Location-Allocation, sort of classic model in spatial statistics and general network analysis. The area of this research has been used in administrative boundary of Young-Dong in Gangneung including 13 emergency, medical hospitals, 46 fire-stations and sub-fire stations. In general terms, what all this show is that the way we are approached for geographical view from using GIS spatial analyzing technique of determined location and allocation problem by the social, economical, political factor and simple administrative discrimination at the meantime. At the same time, with problem occurred in the space it is possible to make an Effective proposal or means, policy, decision for new candidate location-allocation suggesting optimum model.

KEY WORDS: GIS, accessibility, spatial efficiency and spatial equity, vulnerable area, Location-Allocation.

1. INTRODUCTION

1.1 Background and purpose of the study

Recent social-economical development and improving life quality of people have focused greatly on health care. In them, each and every person needs to get the basic facility of emergency health care service. However, emergency medical facilities in recent times have been facing the problem of unbalanced structure of geographical, economical and social factors between rural and urban areas.

To sum up this reason, we can focus on this topics following below;

First, medical care facility are getting unbalanced by problem tied in administration boundary in medical service area.

Second, in established medical service area location of facility need to allocate effectively, but competitive market infrastructure has clustered medical facilities in the populated density areas.

Third, due to competition between medical centers, cooperation system among each health centre is quite impossible.

To solve this problem, this study aimed to locate and allocate effective emergency medical care by using GIS spatial analysis for spatial efficiency to suppliers and spatial equity to demanders. And in this paper, we assess the differences in physical accessibility within a large rural population. Inequality inaccessibility due to distance is. These accessibility studies will help to make the effective decision of local planning and development.

1.2 Analysis methods and used S/W

To study processed the network analysis in GIS spatial analysis, which is following below:

First of all, by using network analysis in finding medical service areas and then search in lacked emergency medical facility.

Next, by using spatial statistic theory determine location and allocation of vulnerable areas.

At the last, basic information for each community planning can decide the substitute area.

Tools used in GIS spatial analysis study is utilized the Arc-GIS, Arc-Workstation, Arc-view GIS basic module expanded module the Spatial Analysis, 3D Analyst, Network and Arc-view scripts. Also using AML(ARC Macro Language) of Arc-info for simplifying the analysis processing.

2. FOUDING VULNERABLE AREA

The area of this research has been used in administrative boundary of Young-Dong in Gangneung including 13 emergency, medical hospitals, 46 fire-stations, sub-fire stations, scale 1/5,000 digital map and represented by points, polygons or node on the network. Use a polygon coverage for applications where census tract data. Use network coverage when demand is at distinct locations (nodes) and the street network is to be used for distance computation.

According to various terms, between emergency medical facilities have divided into four parts and founded for given different weight values of the travel time and the travel distance.

First of all, to analyze medical service areas carried out such analyzing examples "selection of the vulnerable area through each medical facility", "selection of the vulnerable area through emergency transfer area", "selection of the vulnerable area through Estimated time of arrival", "selection of the vulnerable area among medical facilities".

2.1 Selection of the vulnerable area through each medical facility

In the first step, to choose the vulnerable area used medical facility of the nearest distance from the accident spot of patient. Analysis of a general distance have divided particular level and decided the medical service boundary by using road line of the network.

A province emergency medical center and local emergency medical centers has been organized a vulnerable areas of third emergency medical center over 80km area and second emergency medical center over 40km area considering 11 emergency medical center in study area.

2.2 Selection of the vulnerable area through emergency transfer area

The most important thing in public emergency medical service is equivalent accessibility about transfer vehicle.

This accessibility is very important factor in any accident for a patient.

Transfer vehicle for accessibility analysis used the emergency medical center and 119 fire stations and decided the criteria of analysis following time.

A	5 Minutes
B	10 minutes

<Table- 1> the criterion for t ravel time

A: The time required for heart Living operation.

B: The time required for emergency operation after damaged brain.

2.3 Selection of the vulnerable area through estimated time of arrival

This analysis will be finding a vulnerable area by using 119 transfer vehicles as a public transfer medium.

A fire facility is composed by concerning accident rate and popular census in a jurisdiction of the region.

This is available for the analysis of a vulnerable area from accident occurred spot to emergency medical center. This analysis is used by using 46 fire stations and sub fire stations and decided a vulnerable area to fire station and sub fire station spots over 10 minutes to assume using nearest medical centers within the zone.

2.4 Selection of the vulnerable area among medical facilities

For the last vulnerable analysis concerned move among emergency medical facility according to the relative seriousness of the patient.

Emergency medical center is not well equipped for emergency patient. Therefore, it will be the fast alternative method for transferring patient in upper medical center or a special medical center in possible emergency operation with well managed equipment rather than any nearest medical center.

In assume them, analyzing accessible given weight value of a time from the finest third emergency medical center.

2.5 Deriving vulnerable area

As previously focused result, accordingly this is not concerning demanders and suppliers weight analysis of distance and time. However, concerning occurred emergency conditions it is very important to accessible analysis use of the distance and the time weight value on the network.

As in result, it represented entire territory of YounDong boundary as it is lacking emergency medical facility and accessibility towards transfer. In case of Goseong Gun and Yangyang Gun does not have any emergency medical facility, so it depends on the neighbor. Also it is represented vulnerable result for accessibility in the entire region.

3. SPATIAL ANALYSIS FOR EFFECTIVE ALLOCATION

In previously founded vulnerable area, it is necessary to decide best suited candidate to locate and allocate emergency medical resources.

For this study, I used Location-Allocation model at this time.

3.1 GIS model

Location-Allocation model have divided into the continuous model and the discrete model.

Continuous model make assuming infinite in possible site to locate public service facility within the space and discrete model showed allocation of resources by using node point in the network by looking finite.

The difference of this model is that it needs a continuous and a discrete about a variable required data.

Namely, continuous model is to locate any sites of the public service spot within two dimensional spaces by seeing Euclidean space on the spatial conditions.

Discrete model is represented spatial conditions by seeing combination node point and link on the network and it is using accessing method optimum levels for optimal site and location.

3.2 Application of Continuous model

Continuous model can represent efficiency of access about center sites through various variable values for public service facility.

A center point for locating center facility can play a role of psychological center point and physical center point.

For instance, it indicates center point of population, center point of industry, potential analysis of population.

The classification of point for measuring candidate is following below.

point type	Center candidate site	method	weight values
Polygon center	on the polygon feature	Euclidean Distance	population
Node center	on the network	Euclidean Distance	population
Random	on the polygon feature	Euclidean Distance	population

<Table 2> Points type for measuring candidate

As figure on the above, I used 3 ways to represent a point for locating new candidate on the polygon feature.

First, center point of polygon feature is used by center point of polygon considering entire area in polygon boundary.

Secondly, it is used by node point intersecting road line on the network.

Lastly, it presented by using random point that is dot density offering on the arc-view s/w.

3.3 Application of discrete model

As previously stated, continuous model is excluded analysis doing not reflecting geographical character. So, center point of actual location decision should have analysis for using territory activating demander and supplier. Therefore, this analysis will be decide more effective center point by using demand in population data with intersection point of road.

We compared an existing emergency medical facility with Constrained MINDISTANCE, constrained MAXCOVER and MAXATTEND model of LOCATION-ALLOCATION model for this study.

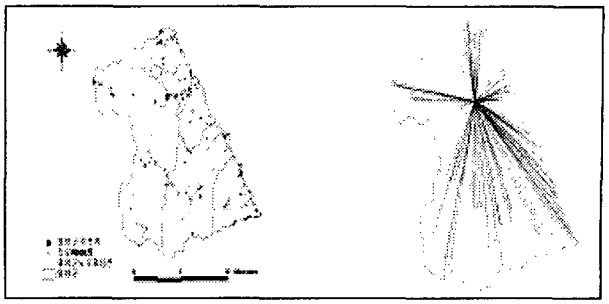
To analysis, it used node point on the network and populations in administrative boundary have divided into node items.

Secondly, we have classified node numbers in each Dong and have decided candidate site to get optimal location about supply.

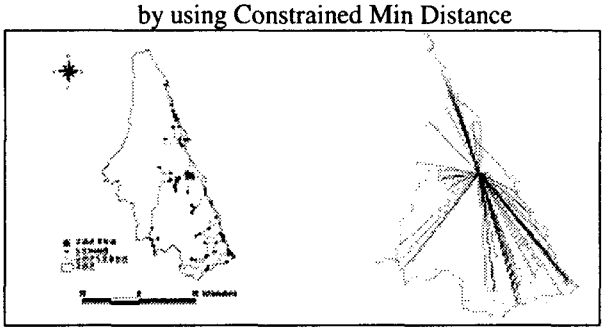
Thirdly, it is accomplished for first analysis of discrete model after finishing composition for basic data.

First of all, by using Constrained Min-Distance Model did to minimize about sum of movement distance between facility and demander.

MINDISTANCE is, minimize the total distance traveled from all demand points to their nearest center and constrained MINDISTANCE is minimize the total distance traveled, while ensuring that no demand is further than a given distance.



<Figure-1> Candidate center of Yangyang Gun by using Constrained Min Distance



<Figure-2> Candidate center of Gosung Gun by using Constrained Min Distance

Area of study is Yangyang Gun and Husung Gun and represented for applied Constrained Min-Distance model.

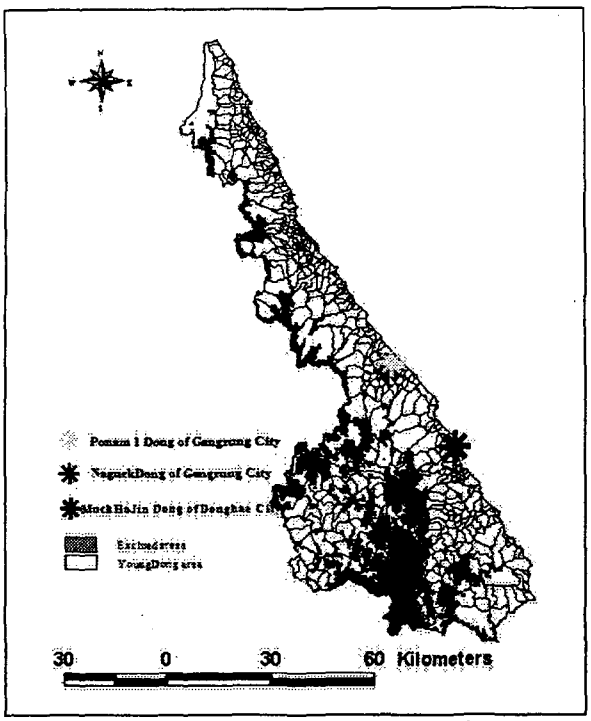
As a result of the above figure, a center point within Yangyang Gun is represented for Semeun Susang Ri by using constrained Min-distance model and the greatest demander is 26,490.7. A center point within Gosung Gun represented for Gansungeup sang Ri and 32206.5 were maximum demand.

Second analysis is seeing the same transfer vehicle about 13 emergency medical facilities and 46 fire stations and have decided optimal site when occurred emergency conditions.

Maximal covering location problem with mandatory closeness constraints is applied within 5 minutes and 10 minutes and had application to road line with speed limit 100km/h, but it does not considering traffic density.

The MAXCOVER model is useful given a required time(e.g., 10 minute)what is the fewest number of facilities required to cover everyone?, what is the trade-off between the number of facilities and the amount of coverage ?

MAXATTEND model is based on the behavioral assumption that the likelihood of attendance decreases linearly with distance. This model tends to locate facilities such that they are in close proximity to the greatest amount of demand. The MAXTTEND model thus tends to locate facilities within areas of higher demand density as opposed to the MINDISTANCE model.



<Figure 3> New designed candidate sites

Beyond this, summing up all the result this paper shows that all the demanding location point is conditionally possible because this is being higher demanding satisfaction point using constrained maximum cover model.

As a result considering population distribution, which is optimal site of new candidate decided in Naguck Dong of Donghae city and the allocation place of supply site considering all supplier selected in MuckhoDong of Dondhae city.

4. CONCLUSION

4.1 Summary

To sum up this study, it is following below.

First of all, I decided the vulnerable area for medical service boundary through emergency medical facility.

Analysis of medical service boundary accomplished "selection of the vulnerable area through each medical facility", "selection of the vulnerable area through emergency transfer area", "selection of the vulnerable area through estimated time of arrival", "selection of the vulnerable area among medical facilities"

Next, the vulnerable area decided a proper new candidate for locating emergency medical facility by using Location-Allocation model in GIS spatial analysis.

A benefit getting from this study is concerning accessibility of public service facility and decide a new candidate site in view of demander and suppliers prospects for solving the problem occurred between space,

In other words, considering spatial equity and spatial efficiency can locate and allocate according to public service facility.

Finally, this will be affectingly very important to improve preservation of human resources and qualities of health service building in region by solving the problems using GIS application according to spatial location and allocation within the area.

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