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Full Length Research Paper

Optimum site selection of natural gas vehicles station in Bangkok using geographic information system

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This paper is to demonstrate the integration of spatial modeling and geographic information systems (GIS) can be used in the optimal site location for natural gas vehicles (NGV) station in Bangkok. Integration has been proposed as one of the characteristics which distinguish GIS from other information systems. Variables used as input in this process mainly address direct construction costs and station efficiency once the structure has been completed. Some of the variables examined include: proximity to population centers, distance from neighboring stations, the easements of using existing utility, car density and speed, land price, and the number of NGV registered car in Bangkok. Increasing levels of interest in the coupled systems, which are often referred to as spatial decision support systems (SDSS) has wide range of application areas. To do spatial analysis using ArcView GIS 3.2 as a tool. The results from this study can be concluded that six locations around Nongjok district were evaluated as the optimal sites for the NGV station in Bangkok.

Key words: NGV station, Bangkok, geographic information systems (GIS), spatial analysis, integration, spatial decision support systems (SDSS).

INTRODUCTION

Due to the increase of urban population and the growth of the number of cars, gas stations are among the places that residents refer to repetitiously. Considering the number of cars and urban population, distributing gas station sites can be effective in shortening urban trip paths. Thus, the number of natural gas vehicles (NGV) facilities and filling stations remained inadequate. Geographic information systems (GIS) provide the appropriate tools for analyzing the effective factors on spatial data and non-spatial data (Bowman, and Lewis, 2006). GIS are powerful computer-based tools for the capture, storage, management, retrieval, query, analysis and presentation of spatial data. GIS ability as spatial data processing and analyses tools available can be used to manage a wide range of Information (Boyles, 2002). GIS provides an integrated computing environment for social and data integration (ESRI, 2005). GIS facilitates the integration of disparate data sets, creation of new and derivative data sets, development and analysis of spatially explicit variables.

The integration has the potential to become a powerful analytical toolbox enabling regional and social scientists to gain fundamental insight into the nature of spatial structures of regional development (Dougherty, 2008). Increasing levels of interest in these coupled systems, which often referred to as spatial decision support systems (SDSS) which make up to wide application areas. Systems coupled with GIS, provide an efficient form for storing, retrieving spatial data and provide a mapping capability for data and final results (Batty and Longley, 1996). The main objective of this study is to find the optimum location of NGV station in Bangkok by integrating information with GIS.

Methodology

Study area

Bangkok is the capital city of Thailand as shown in Figure 1. The transportation and movements of residents is mainly done by private cars, although public buses and taxies are also functioning. The number of NGV stations in Bangkok consist of 76 stations and

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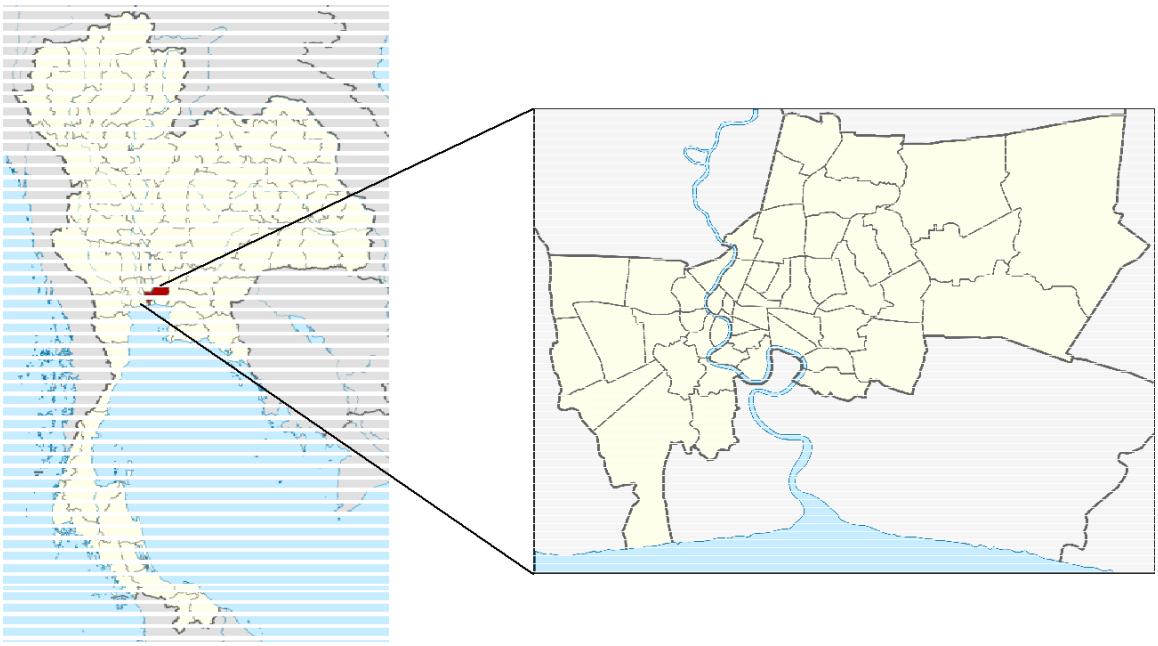

Figure 1. Study area in Bangkok.

the number of NGV car license in Bangkok totally is 122,576 vehicles in 2009.

Methodology used

There are three steps in this study as follows: in the first step, requirement analysis is done, in which the needed spatial and attribute data are identified. The information is gathered and entered to ArcView GIS software. In the second stage the input data is analyzed and the required information layers are made (Harder, 1997). In the last stage by examining the output information from the second stage conclusions and necessary suggestions are made. Several factors played a role in determining the proposed location of the NGV in this study are:

1. The digital topographic maps of Bangkok that contains 7 information layers.
2. The information related to transportation, proximity to population centers, distance from neighboring stations, the easements of using existing utility, car density and speed, land price, and the number of NGV registered car in Bangkok.

ArcView software is then used to generate:

1. The development of the base map for generation of GIS files.
2. The locations of gas stations are specified and their attributes is linked to each spatial feature.
3. Buildings information layer containing the polygons of urban regional divisions and their attributes containing the number of cars, gas stations, and populations.
4. The information layer containing the regions' centers.
5. The spatial decision support systems (SDSS) has wide range of application areas.

Spatial Analyst extension of ArcView is used to compute the distance of each region center to NGV stations. The suitability of each of these sites was assessed against technical, operational and economic criteria (Murphy, 2001) . The technical considerations included the criteria for selection of the NGV stations which are either qualitative or quantitative types are as follows:

1. Site location (urban, rural and residential).
2. Site accessibility (Highway, principal or secondary roads).
3. Fuel and service capacities (No. of fuels tanks, No. of service pumps).
4. Presence of driving factors (supermarket, malls, and highway).
5. Other variables (ATM machines, catering, and area expansion).

RESULTS AND DISCUSSION

To do overlay technique from each parameter that is land price (Figure 2), NGV stations density (Figure 3), population density (Figure 4) and NGV car density (Figure 5), the results demonstrate that the optimal district site location for NGV station in Bangkok is Nongjok district (Figure 6). To do more criteria for specific location using the distance from UTURN is not more than 50 m, the entrance of NGV station nearby, the 12 to 16 meter-width road and also network analysis. Six locations around Nongjok district were evaluated as the optimal sites for the NGV station (Figure 7).

CONCLUSIONS AND RECOMMENDATIONS

The GIS knowledge and its practical software can be useful in analyzing and finding out how the optimal site locations for NGV stations in Bangkok. The results of the

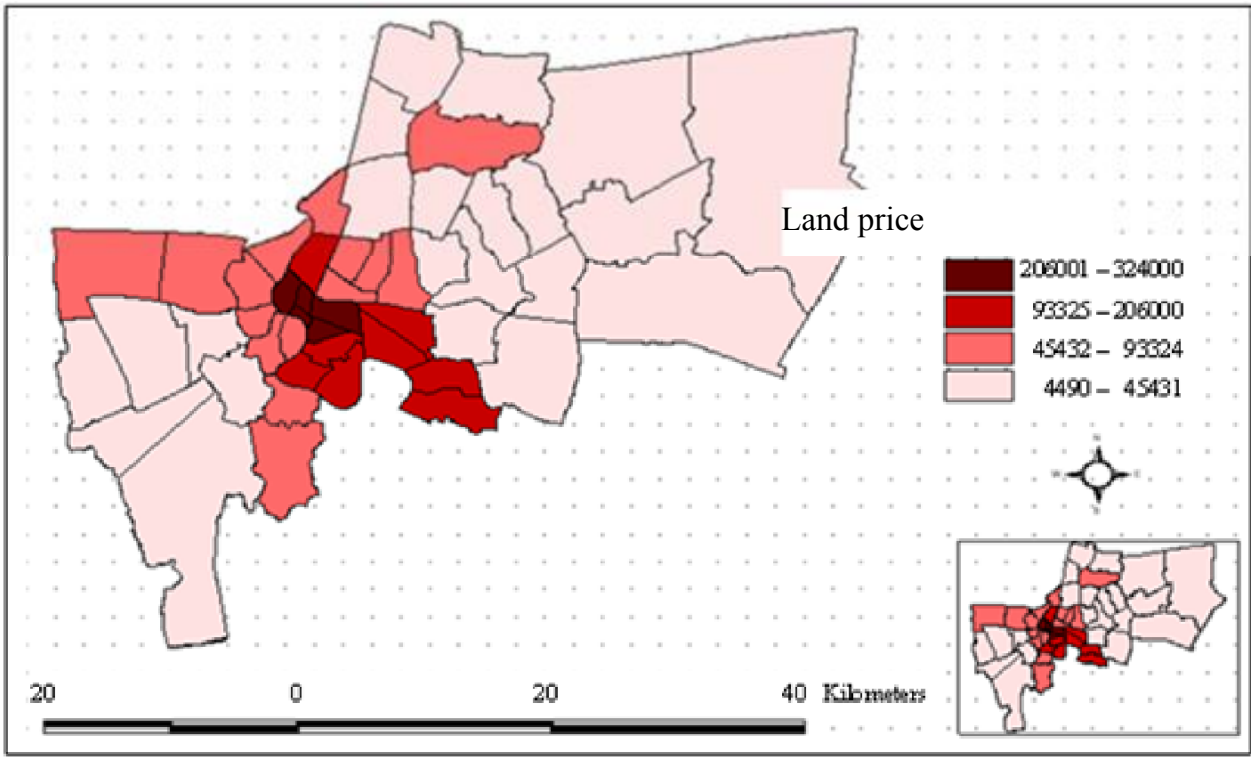

Figure 2. Land prince density.

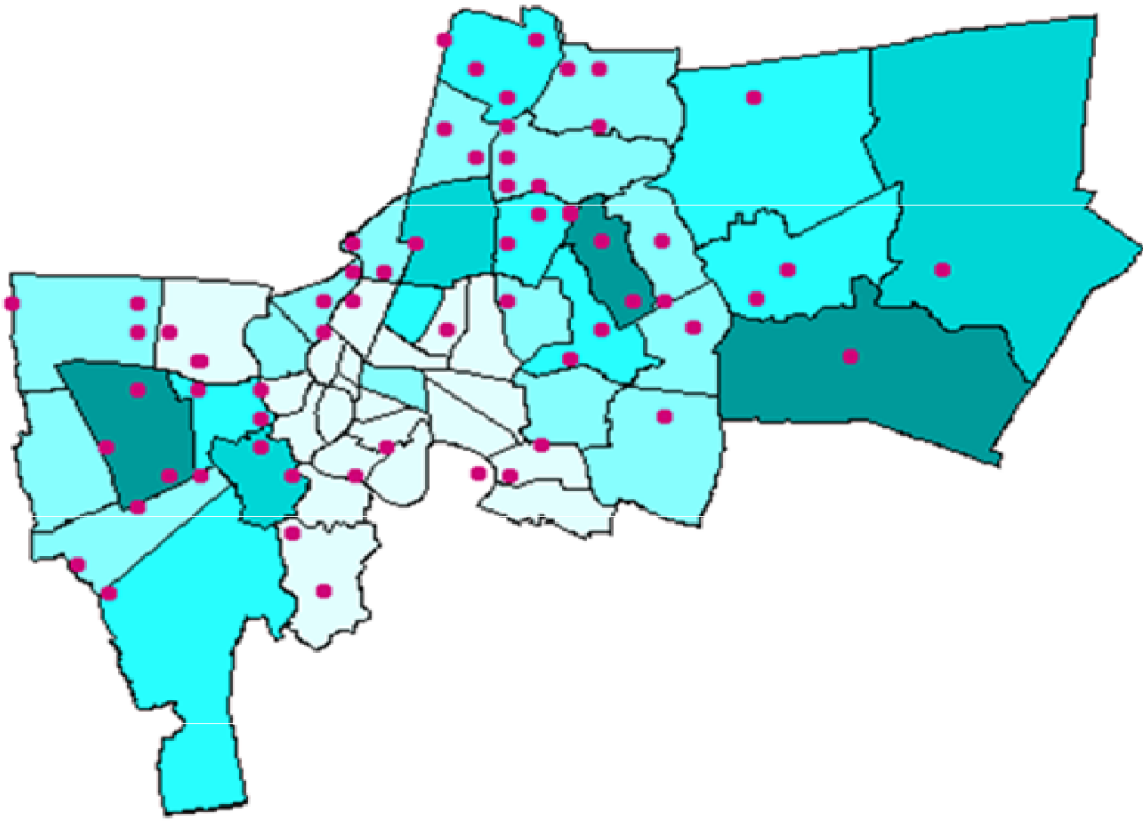

Figure 3. Current NGV stations position in Bangkok.

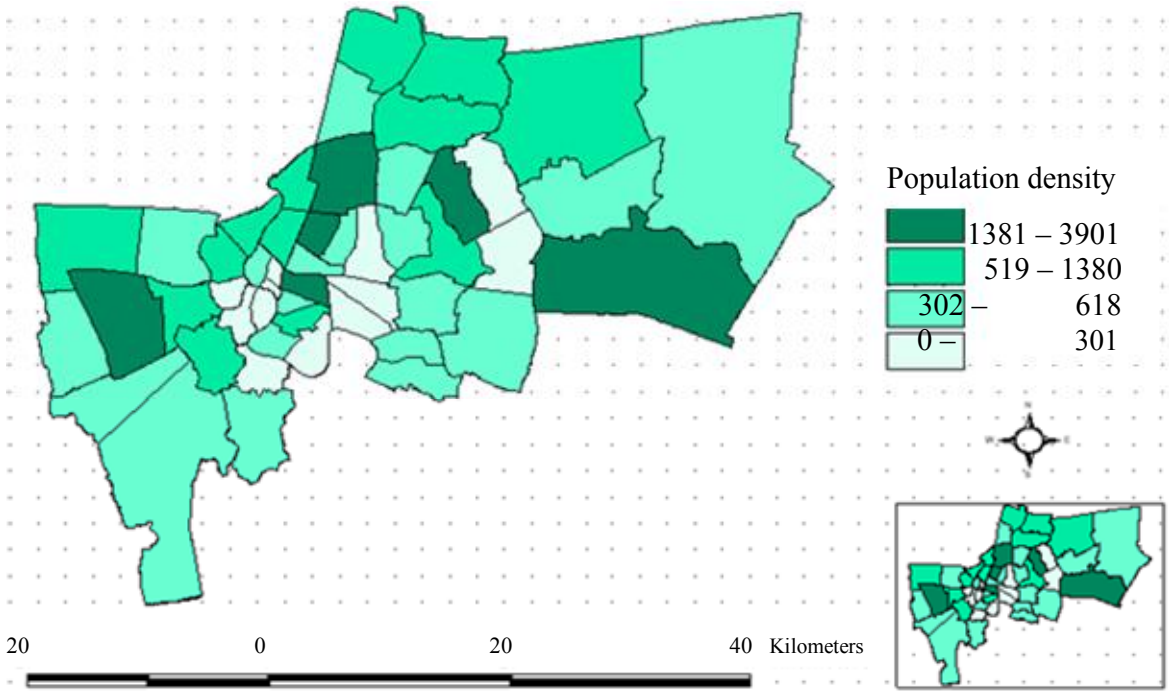

Figure 4. Population density in Bangkok.

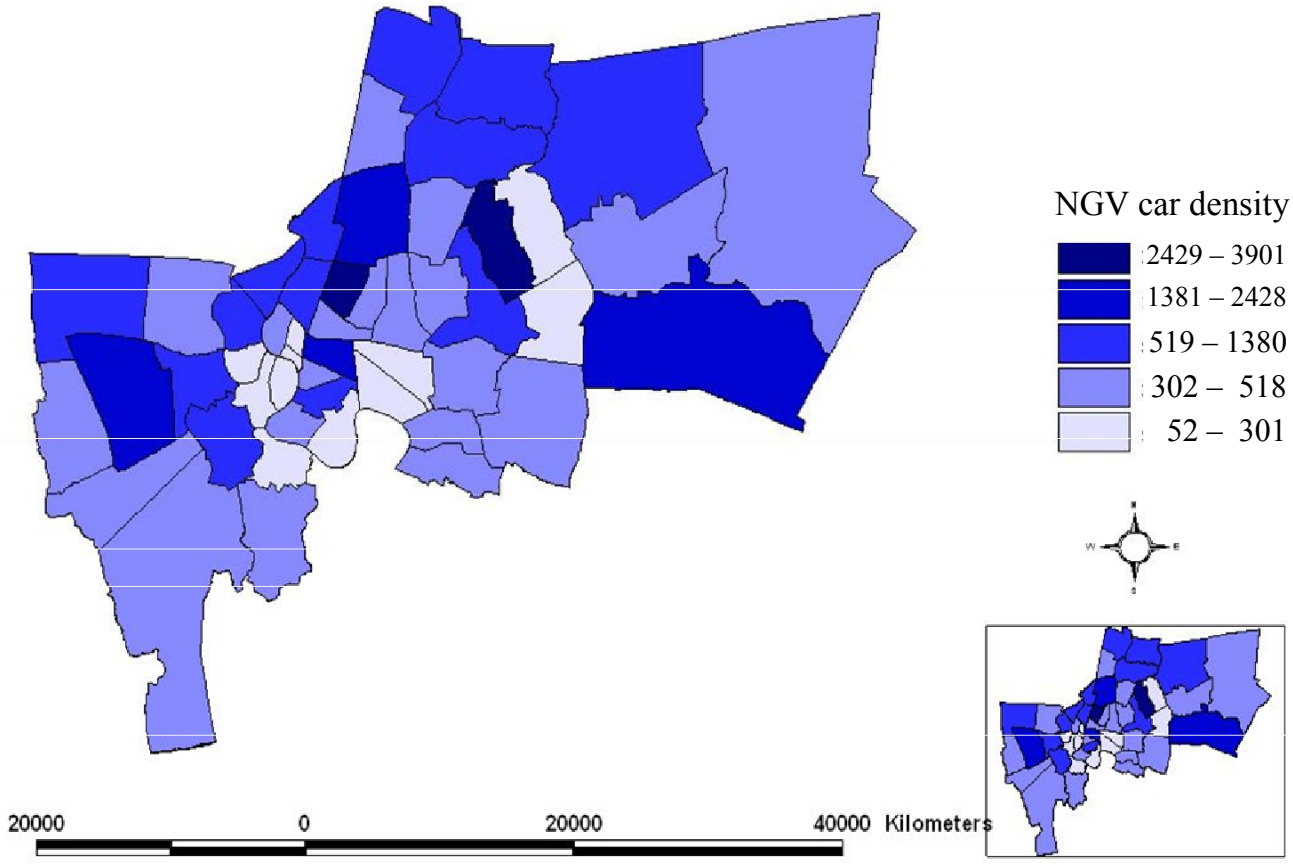

Figure 5. NGV car density in Bangkok.

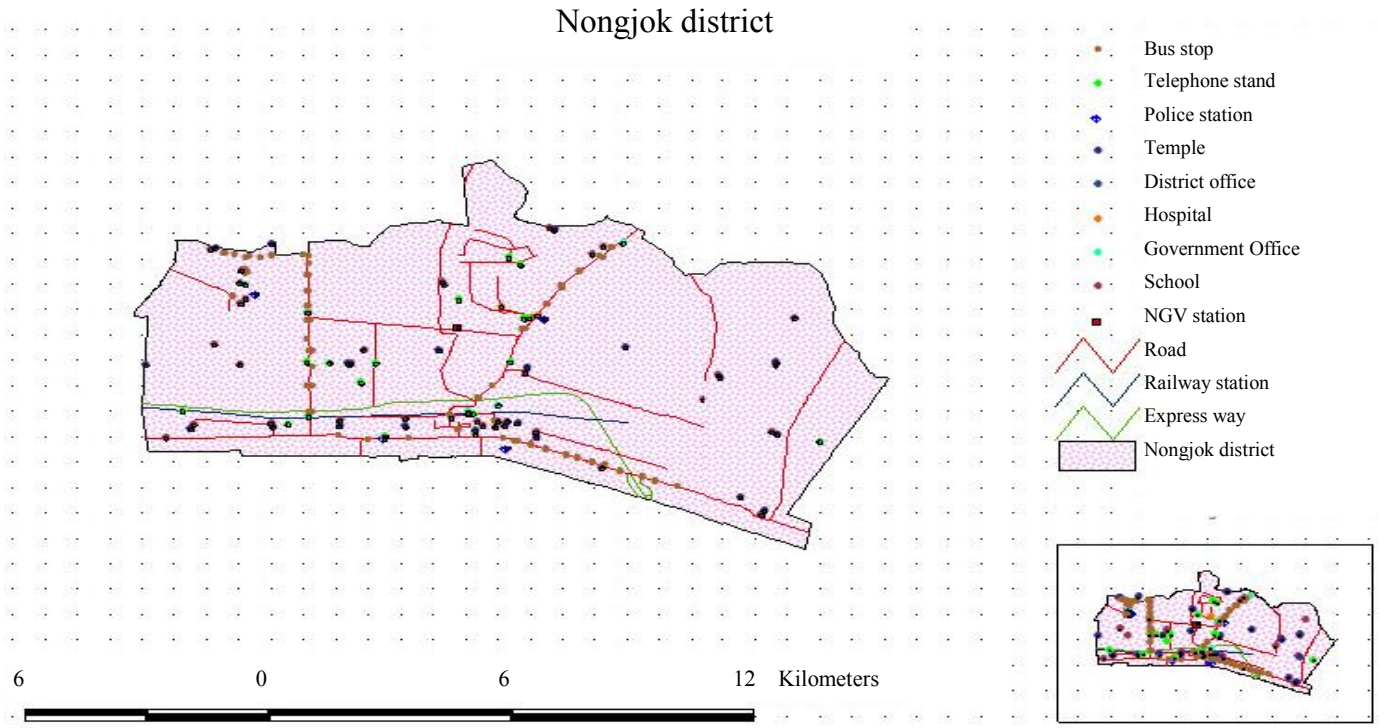

Figure 6. The optimal district site location for NGV station in Bangkok.

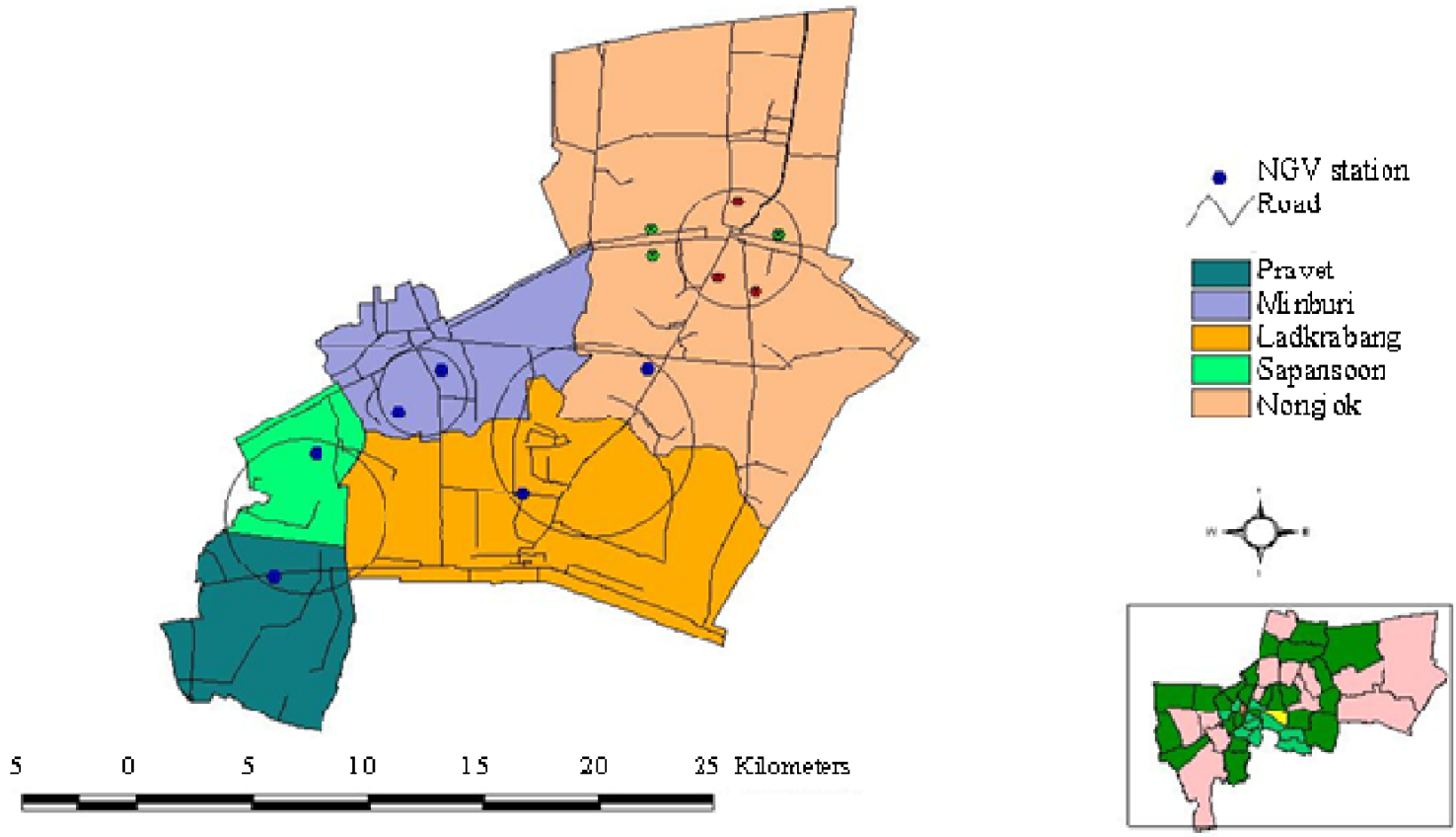

Figure 7. Six optimal locations around Nongjok district for NGV stations.

examinations show that we can specify the potential of the site locations for NGV stations for each region in comparison to other regions. In this examination by focusing on the site selection method of gas stations and high potential regions were specified (Swenson, 1996). The proposed sites at Nongjok district were selected for several other reasons that were close to the urban centre of Nongjok, but sufficiently far removed to minimize disturbance.

There are potential benefits related to the proximity to Industrial Real Estate in Chachengsoa Province which fit with accessing to local support services; not far from UTURN less ore than 50 m and also the entrance of NGV station nearby, the 12 to 16 meter-width road and also network analysis. The results showed that there are six optimal site locations for NGV stations in Nongjok district in Bangkok. It is suggested to study this subject by considering other factors such as accurate street data are critical for supporting geocoding, routing, architecture and road building methods in regions and compare the results with this research. Finally, GIS based decision support systems to decide where to set up a NGV station.

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