

# Research on Promotion of Public Security using Geographic Information System

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Key words : Geographic information system, Public security, Secondary data

## Abstract

In the last decade, the development of geographical information system (GIS) has provided a powerful insight into research in several academic fields. A look at the electronic library service CiNii reveals that the number of articles is increasing year by year, not only in geography but also in various academic fields, such as public health, pedagogy, and criminology. The present study outlines the functions of GIS, especially mapping, and indicates their manner of utilization for public security. Recently, the public security policy has moved in a direction such that it has begun to concentrate on delivery and planning at the community level and not the prefecture level. GIS constitutes a powerful tool that can support this movement; however, the successful and meaningful use of GIS depends on the data sources. Unfortunately, most of the published data constitute those reported by large administrative areas. If data at the community level are available, the results obtained using GIS could be contributed to policy making.

## Introduction

In the last decade, the development of geographical information system (GIS) has provided a powerful insight into research in many academic fields. It has been difficult to arrive at a consensus definition of GIS; however, simply put, it refers to computer-based systems for the integration and analysis of geographic data

(Cromley & McLafferty, 2002). In other words, GIS constitutes powerful tools for the capture, integration, modeling, analysis, and visualization of spatial patterns and processes. Before it become a popular tool in the academic field, GIS was used not only by government organizations for tasks such as determining the supply of commodities such as gas and water but also by commercial organizations for the purpose of market research and planning.

In Japan, following the Hanshin-Awaji Earthquake of January in 1995, the government began to discuss the promotion of GIS. Thus, it was time to commence the systematic promotion of GIS; one of the outcomes of these promotion endeavors was the GIS action program, which was formulated by the government. In addition, as mentioned above, GIS has, over the previous years, emerged as a tool in academic research. A look at the electronic library service CiNii reveals that the number of articles is increasing year by year not only in geography but also in various academic fields, such as public health, pedagogy, and criminology. The one reason for this may be due to improvements in software. For now, we can access it at a convenient price, and easy to use even by beginners. In recent years, some elementary schools have been attempting to spread GIS literacy.

The purpose of this study is to provide the functions of GIS, especially mapping, and indicates their relevance in public security. Due to

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the economic recession around for 10 years, fear and insecurity for everyday life are rapidly rising among the public, therefore making public security is one of the imperative issues that needs to be address. For example, as indicated by the Japanese Cabinet Administration Office “Opinion Poll on public security,” over the half of the respondents felt that Japan was not a safe place to live in (Cabinet Office, 2004). Some other study also pointed out community characterized by anonymity and sparse acquaintanceship networks among residents might encourage criminal behavior (Putnam, 2000). In short, living in a community characterized by high mobility raises the possibility of the risk of becoming a victim of crime, as compared to living in a more stable community.

To make a clear the usefulness of GIS, we compared the GIS perspective with traditional statistical approach; a correlation analysis. Thus, we first performed to indicate statistical relationship between the crime rate and compositional factors such as mobility and the population makeup. Subsequently, we used GIS to identify the geographical concentration of crime and the relation of this factor with the composition of municipalities in Niigata prefecture.

**Current situation of crime cases reported to the police in Niigata prefecture**

*Statistical Perspective using a Correlation Analysis*

In this study, we analyzed secondary data obtained from the Niigata prefecture website (Niigata Prefecture, 2007). Crime cases reported

to the police per 10,000 population were used as the crime variable. The rate of out-migrants to other municipalities and the population ratio [15-64 years old] in each municipality were used as the compositional variables. Table 1 provides the correlations for the variables used in this analysis. The table shows that the crime cases reported to the police were significantly correlated with the rate of out-migrants to other municipalities ( $p = 0.000$ ) and the population ratio [15-64 years old] ( $p = 0.010$ ).

However, it is hard for public to understand what the statistical result showed and its meaning exactly. Presenting the results in a clearer, simpler form will enable people to identify the current situation at first glance and arrive at better explanations for the occurrence of such crimes in the specific geographical area or find means to address these situations in terms of an interdisciplinary approach.

*Mapping of the Crime Case using GIS*

GIS can be used to map geographical distributions. First, we established patterns by examining the distribution of the features on the map. Thereafter, we combined the data on location so as to answer the question of why this distribution occurs in terms of the demographical aspect. A map is constructed using geographical data by referring to rates or ratios; choropleth mapping is the preferred approach.

Fig. 1 provides a choropleth map of the crime cases reported to the police in Niigata prefecture. The darker color represents the municipalities with higher crime case, while the bright color

Table 1 The result of correlation between the variables

	Rate of out-migrants to other municipalities	Population ratio [15-64 years old]
Crime case	0.622**	0.457*

\*\* $p < 0.01$

\* $p < 0.05$

represents those with lower crime case. It was observed that the higher crime case pertained to larger municipalities such as Niigata city and Nagaoka city. As seen above, the map presents a clear idea of the current distribution of crime case; such lucid results thus ensure the accuracy of information.

Fig. 2 also provides the distribution of crime case, similar to Fig. 1; however, in this case, we integrated other spatial data such as that on out-migrants to other municipalities. The municipality represented as an “A” in Fig. 2 is that with the highest crime case category and the highest proportion of out-migrants to other municipalities category, while represented as a “B” indicates the lowest crime case category and the lowest out-migrants to other municipalities category.

Fig. 3 provides the distribution of crime case and the population ratio [15-64 years old]. The municipality represented as a “C” in Fig. 3 is that

with the highest crime case category and the highest population ratio [15-64 years old] category, while represented as a “D” indicates the lowest crime case category and the lowest population ratio [15-64 years old] category.

Our mapping raises interesting issues; in statistical terms, it provided a positive correlation between crime case and compositional factors such as out-migrants to other municipalities and the population ratio [15-64 years old]. However, Fig. 2 and Fig. 3 showed that higher compositional factors that imply poorer compositional conditions in the municipalities do not always lead to a worse crime case. For example, this is provided by the municipality represented as an “E” in Fig. 2 is that with the lowest crime case category and the highest rate of out-migrants to other municipalities category. A discussion on this issue is beyond the scope of this paper; however, simply put, GIS can explore geographic variation, while statistics cannot.

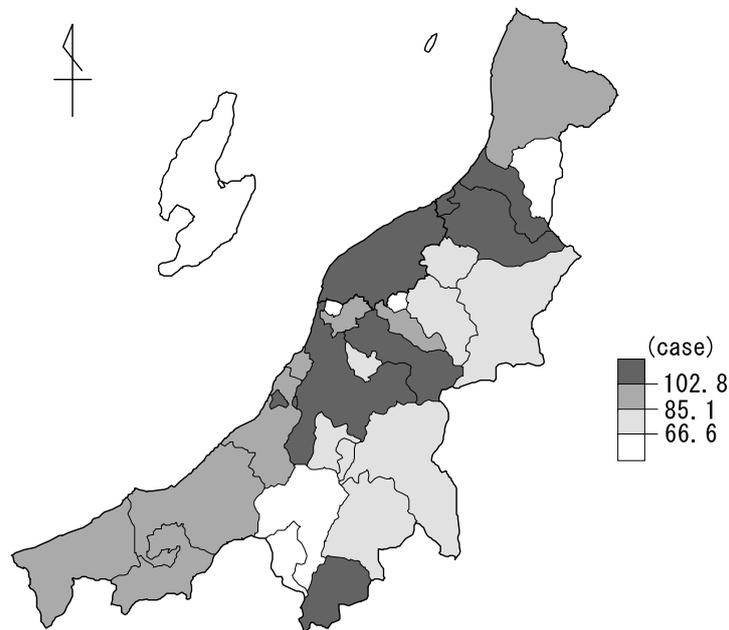


Figure 1. Current situation of crime cases reported to the police in Niigata Prefecture

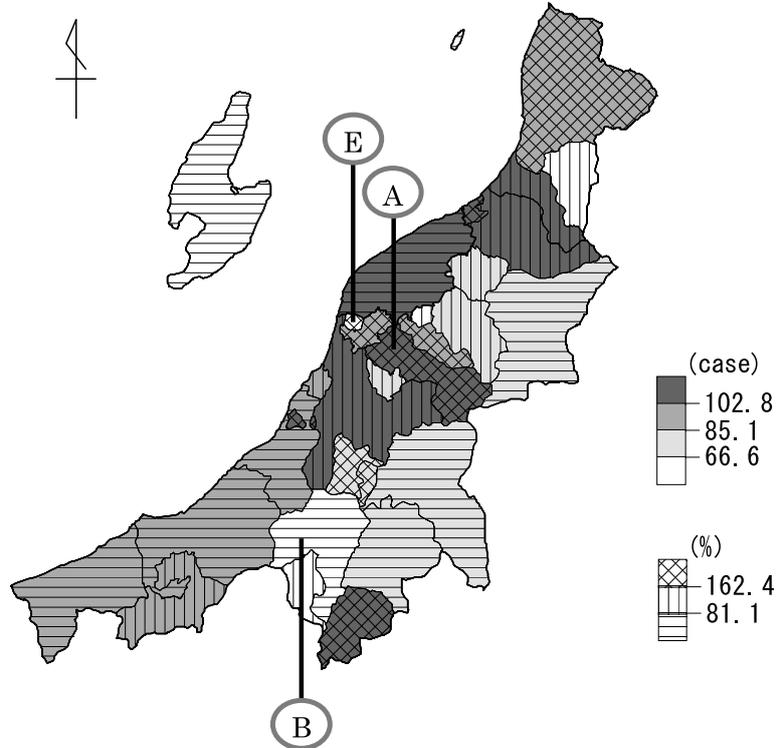


Figure 2. Crime cases reported to the police and the rate of out-migrants to other municipalities

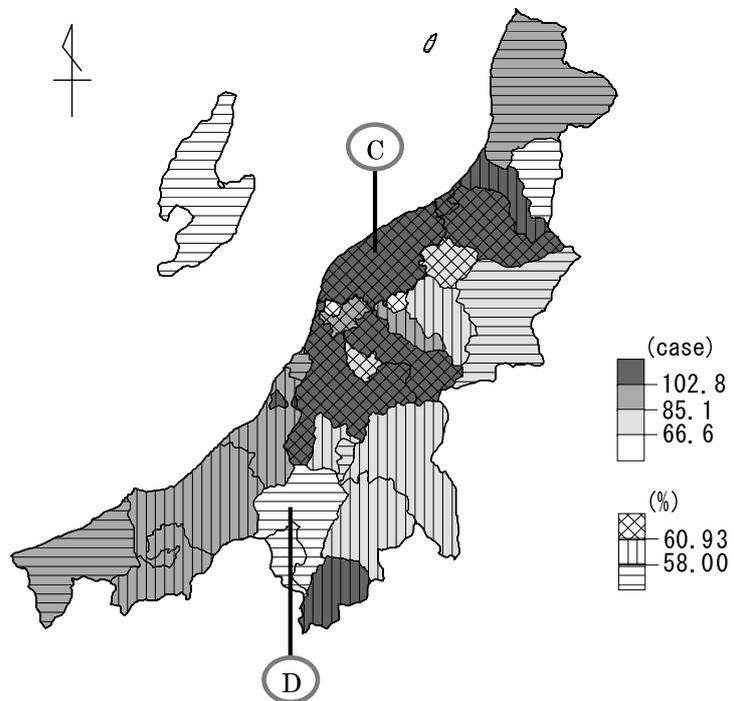


Figure 3. Crime cases reported to the police and the population ratio [15-64 years old]

This study has some limitations. First, the choice of class intervals is an important issue (Sekine, 2000). Changing the class interval produces different impacts and message it sends. Second, we focused on the mapping function of the geographical distribution and concluded that it does not do well in representing complex causality.

### Conclusion

In this study, we hypothesized that stability within a municipality produces public security. The reason for this is the lack of communication between the old residents and newcomers; this situation leads to the loss of mutual help and the breakdown of norms. We were unable to demonstrate the causality in this case; at best, GIS provides evidence indicating the possibility that some municipalities fulfill this hypothesis. A few studies recently have conducted similar research; however, these differ from ours in that they capture mutual help and norms within communities in terms of the concept of social capital. Social capital is defined “Social capital here refers to features of social organization, such as trust, norms, and networks, that can improve the efficiency of society by facilitating coordinated actions” (Putnam, 1993). Although further research is needed to substantiate this, it has been pointed out that social capital contributes to public security (Lindström, Merlo, & Ostergren, 2003; Sampson, Raudenbush & Earls, 1997).

GIS presents a new perspective that differs from the traditional statistical approach. In recent years, the public security policy has moved in a direction such that it has begun to concentrate on delivery and planning at the community level and not at the prefecture level. GIS is a powerful tool that can support this move; however, reliable data sources are needed to promote its effective use in the future. An important issue discussed here is the lack of spatial data within the official

statistics. In other words, while the successful and meaningful use of GIS depends on the data sources, most of the published data unfortunately constitute that reported by large administrative areas. If data are available at the community level, the results obtained using GIS could be employed in policy making.

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