



## **Jurnal Pertahanan**

Media Informasi tentang Kajian dan Strategi Pertahanan yang Mengedepankan *Identity, Nationalism* dan *Integrity*  
e-ISSN: 2549-9459

<http://jurnal.idu.ac.id/index.php/DefenseJournal>



### **GEOGRAPHIC INFORMATION SYSTEM (GIS) FOR MAPPING OF DRUG ABUSE USING SPATIAL CORRELATION ANALYSIS IN NORTH SUMATRA PROVINCE**

**Fitri Isnaini**

Balai Besar Rehabilitasi Badan Narkotika Nasional  
HR Edi Sukma Street, Bogor, West Java, Indonesia 16110  
[fitriisnaini@gmail.com](mailto:fitriisnaini@gmail.com)

**Narwawi Pramudhiarta**

United Nations Population Fund, UNFPA  
Menara Thamrin 7th Floor, M. H. Thamrin Street Kav. 3, DKI Jakarta, Indonesia 10250

#### **Article Info**

##### **Article history:**

Received 29 July 2020

Revised 7 December 2020

Accepted 26 December 2020

##### **Keywords:**

Drugs,  
Environment,  
Geographic Information System,  
Rehabilitation,  
Vulnerability

#### **Abstract**

Drug abuse is a problem that affects almost every country in the world including Indonesia. In the long term, it has the potential to disrupt competitiveness, weaken national resilience, and can hinder the progress of a nation. North Sumatra is a province that has the highest prevalence of drug abusers in Indonesia, which none of the villages in this Province is free from drug abuse. The North Sumatra Province also has the highest number of drug abusers undergoing rehabilitation at the BNN Rehabilitation Center. The use of geospatial technology can help understand the phenomenon of drug abuse by area or spatial. One of the geospatial technology that commonly uses is the Geographic Information System (GIS). This study aims to show that GIS can be used in mapping drug-prone areas in North Sumatra based on North Sumatran people undergoing drug rehabilitation. The method used is a retrospective based on secondary data and spatial statistics in GIS. The environment prone to drug abuse based on the number of people undergoing drug rehabilitation at the BNN Rehabilitation Center from North Sumatra is divided into 3 zones based on the number of clients distributed in BNN Rehabilitation Center, namely red, yellow and green. Red zone 3 cities/districts namely Deli Serdang, Medan, and Binjai with 9 sub-districts namely Percut Sei Tuan, Medan Amplas, Medan Helvetia, Medan Tembung, Medan Perjuangan, Binjai Utara, Medan Sunggal, Medan Johor, Medan Timur. The yellow area has 25 districts, the green area is 103 districts. In a conclusion, the Geographic Information System (GIS) is a technology that can be used to map drug-prone areas.

DOI:

<http://dx.doi.org/10.33172/jp.v6i3.879>

© 2020 Published by Indonesia Defense University

## INTRODUCTION

Drug abuse is a global phenomenon, affecting almost every country, but its extent and characteristics differ from region to region. Drug abuse globally is a transnational and multi-sectoral crime. Therefore, in the long term, it has the potential to disrupt competitiveness, weaken national resilience, and can hinder the progress of a nation. Isnaini et al. (2018) in their research on the spatial analysis of the influence of socio-economic vulnerability to drug abusers in Indonesia in 2015 stated that the defense and security of the Indonesian nation could be affected by the level of risk of drug abuse. The number of cases of drug abusers such as the iceberg phenomenon that appears on the surface of the sea appears small on the upper surface and large below, hidden, and invisible (Sandi, 2016).

In 2018 the prevalence of drug abusers among students in 13 provincial capitals in Indonesia reached 3.2%, equivalent to 2.29 million people (BNN, 2019a). This is quite worrying because students are candidates for human resources in the future development of the nation and state. Data on teenagers accessing rehabilitation services in the drug rehabilitation center national narcotic board every year increases (BNN, 2019a). Usman et al. (2003) say that human resources are important because they are a static or natural aspect of a nation's national resilience.

The National Narcotics Agency of the Republic of Indonesia (BNN) reports that no village in Indonesia is free from drug abuse. The report of the Indonesian Central Statistics Agency (BPS) in the Village Potential Report (PODES) 2010 also indicates that there are drug problems in all villages in Indonesia. The prevalence of drug abuse and the types of drugs used for the first time also varies between provinces in Indonesia (BNN, 2015). This shows that geographic areas can influence patterns of drug abuse.

Mennis et al (2016) suggest that it is necessary to illustrate where, why, and how

such inequities in risky substance use environments occur, the implications of such inequities for disparities in substance use disorders and treatment outcomes, and the implications for drug policies include prevention and treatment programs. Mendoza et al. (2013) in their research about assessing the spatial distribution of risk in Buffalo, New York, shows that neighborhood geographical markers can be used to determine areas with an elevated risk that may lead providers to better target and address substance use disorder prevalence in communities. The highest risk for negative treatment outcomes in areas with either high socioeconomic or physical environmental risk.

Analyzing the risk of drug abuse based on socio-economic vulnerability and the prevalence of drug abuse in 2015 shows that Indonesia has various levels of risk. High levels are in DKI Jakarta, East Kalimantan, Riau Islands, West Java, and North Sumatra (Isnaini et al., 2018). In 2015, the three provinces with the highest number of abusers in Indonesia were DKI Jakarta, North Sumatra, and East Kalimantan. In 2019, the three provinces with the largest prevalence of drug abusers are North Sumatra, South Sumatra, DKI Jakarta (BNN, 2019b). Based on a report from the BNN Rehabilitation Center, which is the largest rehabilitation center for drug abusers in Indonesia, the number of people undergoing rehabilitation from North Sumatra in the last 5 years is among the highest.

The total number of drug abuse in North Sumatera Province shows a high prevalence and a large number of drug abusers undergoing rehabilitation which indicates that the problem management of drug abusers in North Sumatra requires a more effective and comprehensive effort. The total number of drug abuse only able shows the quantities, not the area distribution area. The use of technology that can help understand the phenomenon of an area or space namely the Geographic Information System (GIS).

Geographical Information System (GIS) is a computer system used to capture, store, query (attribute selection), analyze, and display geospatial data. Geospatial data is data that describes the location and characteristics of a spatial (spatial) element. Management of this data can use a technique called spatial analysis (Kemenristek RI, 2013).

The spatial analysis not only helps to understand a spatial phenomenon but also its structure/components. This is because the spatial analysis is an interaction between spatial objects (Sadahiro, 2006). Therefore, spatial analysis can be used to assist planning, and provide a basis for policy or decision making (ESRI, 2016). The idea of using GIS for substance abuse research was made aware to the researchers when they found out that there was a strong association between diseases and environmental surroundings (Pereira et al., 2010)

Risk assessment and spatial analysis techniques to the study of violence have been applied in the prior research. Kennedy et al. (2016) in their paper offers an analytical strategy to model risky places that combines the conceptual insights of crime emergence and persistence, advance geospatial analytical techniques, and micro-level data. Fazillah et al. (2018) demonstrate the usefulness of a combination between a geographic information system and a multivariate analysis in substance abuse research. Mohd Ekhwan et al. (2015) also study about the spatial and temporal assessment of drug addiction in Terengganu Malaysia to understand the geographical area of the district in the same cluster, besides, identify the hot spot area of this problem and analysis the trend of drug addiction using multivariate analysis and GIS.

Geographically focused or place-based, policing practices have consistently demonstrated effectiveness. GIS was seen as a powerful evidence-based practice tool

for early problem detection and solving (Boulos, 2004) The visual presentation and distribution of any particular disease and association to any factor may be presented using a map will lead to identifying the impact of those diseases to the population, and hence it may help in identifying risk areas for further action. The capability of GIS in managing both spatial and non-spatial information provides an excellent framework for disease management (Srivastava et al., 2009).

Limited human resources and funds in combating drug abuse require policymakers to be able to set program target priorities. The capability of the Geographic Information System (GIS) in analyzing phenomena related to the environment can help analyze the environment prone to drug abuse in North Sumatra. Where this can be used as a guideline in formulating strategies for the prevention, eradication, abuse, and illicit drug trafficking (P4GN) that are more effective and efficient in the North Sumatra environment. The purpose of this study is to show that the Geographic Information System can be used in mapping drug-prone areas in North Sumatra based on people undergoing rehabilitation at the BNN Rehabilitation Center from North Sumatra.

## METHOD

This study is a retrospective descriptive study using secondary data, namely the addresses of people undergoing drug rehabilitation at the BNN Rehabilitation Center from North Sumatra Province. A retrospective study uses existing data that have been recorded for reasons other than research. A retrospective case series is the description of a group of cases with a new or unusual disease or treatment (Hess, 2004). It can also be interpreted that a retrospective study investigates outcomes specified at the beginning of a study by looking backward at data collected from previous patients (Powell & Sweeting, 2015).

### Description of the Study Area

The study area is in North Sumatra Province, one of the provinces in Indonesia, and its capital is Medan. Located at 1°-4° North Latitude and 98°-100° East Longitude, it covers an area of about 72,981.23 km<sup>2</sup> and consists of 33 regencies/cities. North Sumatra Province has a population of 12,985,075 people in the 2010 national census, the 4<sup>th</sup> populous province in Indonesia.

### Data

1. Address data of clients undergoing drug rehabilitation from North Sumatra at the BNN Rehabilitation Center Jl. Mayjend H.R Edi Sukma KM 21 Wates Jaya Village, Cigombong District, Bogor Regency, in 2017 and 2018.
2. A topographic map of North Sumatra is obtained from the Central Bureau of Statistics.
3. Data on drug-prone areas obtained from the National Narcotics Agency in 2019
4. Demographic data for the North Sumatra region from the Central Statistics Agency in 2018 in the form of population density, open unemployment, percentage of poor people, human development index, economic growth rate, male population, female population, gender ratio, number of facilities Health, number of crimes, number of narcotics crimes.

### Tools and Materials

1. Laptop with Intel processor Core i7-5500 CPU 2.24 GHz, 16 GB RAM, 512 SSD, 2 TB HDD, Graphics 2GB.
2. ArcGIS Desktop 10.8

### Data Analysis

Data analysis used in this study is a form of qualitative analysis, according to (Hasan, 2012) qualitative analysis is an analysis that does not use mathematical models, statistical and econometric models, or certain other models. Just read the available tables, graphics, or figures, then decompose and interpret them. The unit of analysis

used is the administrative boundary of the village. In this study, there are four steps for data analysis

1. The data cleaning process, line data about client addresses from North Sumatra is broken down into provinces, districts/cities, sub-districts, villages. And then that is the codebase on BPS coding. If it's incomplete client data, then it doesn't count.
2. Spatial analysis, making a map of the distribution of drug addiction at the district/sub-regional level. Then the areas/zones are grouped into 3 (red, yellow, green) so that we can find out which environment is more vulnerable.
3. Spatial analysis, making a map of drug-porn areas base on BNN data.
4. Overlay map of the distributions client addresses from North Sumatra attending drug rehabilitation at the district / sub-regional level, with the drug porn area.
5. Analysis of the overlay map.
6. Conduct red zone analysis by overlay the demographic and the distribution of drug abuse data.

### RESULTS AND DISCUSSION

The results of data collection on people from North Sumatra undergoing rehabilitation at the BNN Rehabilitation Center in 2017 and 2018, there are 532 address data. The data obtained is in the form of complete address data, without separating the names of the street, sub-district, sub-district, and district/city.

The results of data cleaning show only 529 data can be processed due to incomplete addresses. Complete in the sense that there are names of Villages, Subdistricts, Districts/Cities Provinces, however, this study only shows the results up to the district level for policy planning recommendation.

A visual representation of spatial data on drug abusers from North Sumatra undergoing rehabilitation at the BNN Rehabilitation Centre Lido in distribution is illustrated in Figure 1. Based on the spatial analysis as shown in Figure 1, the number

of drug abusers from North Sumatra undergoing rehabilitation at the BNN Rehabilitation Center Lido by district varies. Referring to the map, the prone environment is identified and analyzed.

The vulnerable environment refers to the area with the highest number of drug abusers undergoing rehabilitation. The clustering method is divided the total number of drug abuse into 3 classes using a normal curve namely high (red), medium (yellow), and green (low) using a normal curve in GIS software.

The red area (cluster 1) shows the highest number of abusers undergoing rehabilitation, 12-22 clients. The yellow area (Cluster 2) shows the number of drug abusers as many as 5-11 clients. Areas in green (Cluster 3) indicate the number of abusers undergoing rehabilitation of 1-4 clients. There is an area that appears colored around it, which indicates that the area closest to the area also has drug abusers undergoing rehabilitation.

The area is located around the provincial capital namely Medan. This shows that an area that is the center of the economy, which of course has better transportation access than other areas, has better access to rehabilitation services. Detecting with certainty cases of drug problems in an area is very difficult because drug problems are problems that are like icebergs.

The existence of information regarding the number of abusers in an area can be used as an indication of drug problems that occur in an area. Seeing this, the areas that appear in color can mean that there are many drug users in the area and the area is more vulnerable to drug abuse. The summary and interpretation of the number of drug abuse by district/city in the red, yellow, and green areas are shown in Table 1.

In Table 1 we can see that there are 3 cities/regencies in the red area (Cluster 1) which can be said to be a vulnerable environment, namely the City/District of Deli Serdang, Medan, and Binjai. If the results of the spatial analysis are described

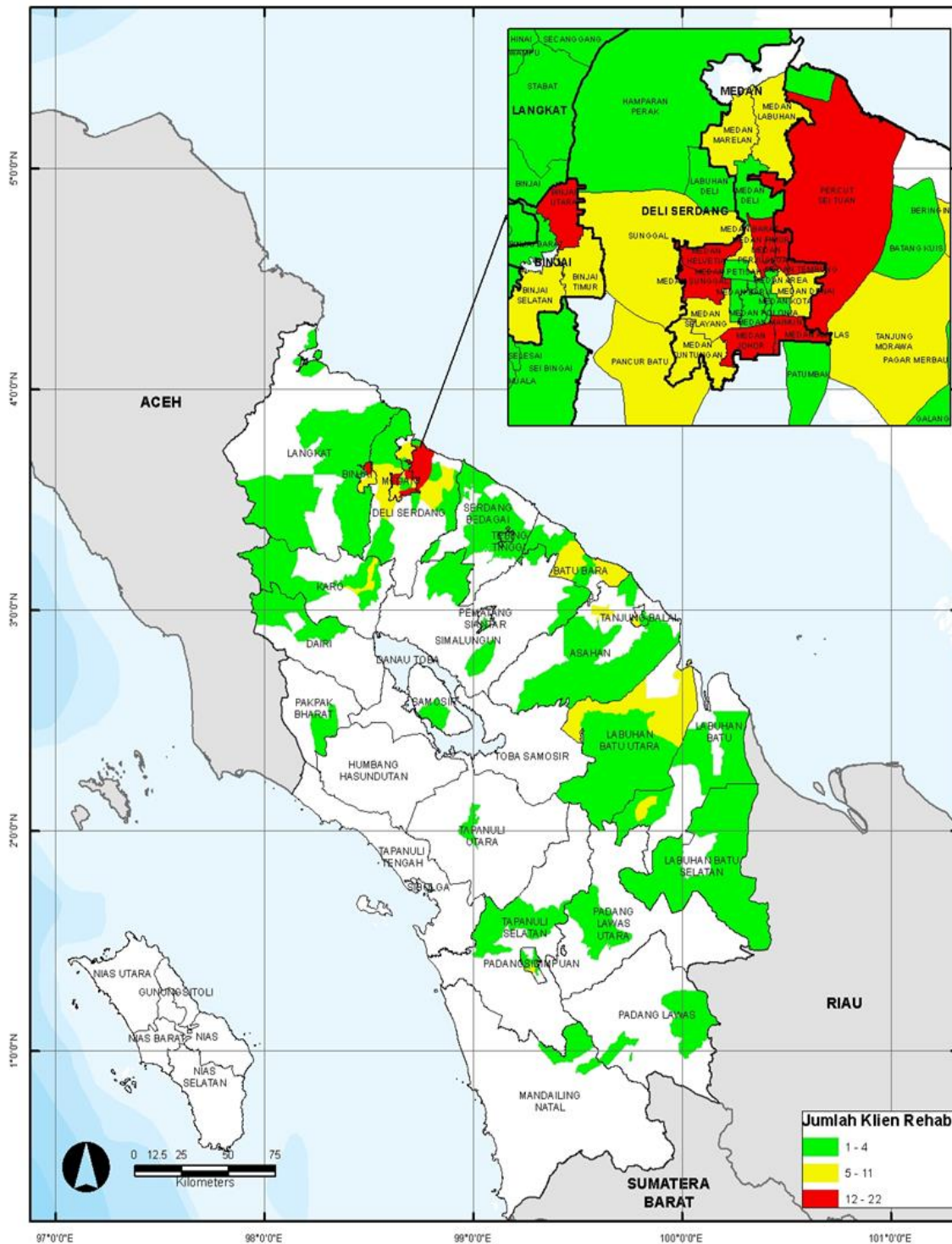
based on the district, then in the red area there are 9 subdistricts, namely Percut Sei Tuan, Medan Amplas, Medan Helvetia, Medan Tembung, Medan Perjuangan, Binjai Utara, Medan Sunggal, Medan Johor, Medan Timur.

In the yellow area (cluster 2) there are 11 city/district which has a sub-district that is in the yellow area witch are Medan Karo, Asahan, Labuhan Batu, Deli Serdang, Labuhan Batu Utara, Binjai, Batu Bara, Tanjung Balai, Padangsidimpuan, Karo. There are 25 Sub districts of the region, namely Kisaran Barat, Kabanjahe, Medan Selayang, Tanjung Morawa, Rantau Utara, Medan Denai, Medan Tuntungan, Lubuk Pakam, Tanjung Tiram, Binjai Timur, Beringin, Sunggal, Kualuh Hulu, Medan Area, Kisaran Timur, Binjai Selatan, Kualuh Hilir, Medan Labuhan, Limapuluh, Pancur Batu, Berastagi, Medan Barat, Medan Marelan, Padangsidimpuan Selatan, dan Datuk Bandar.

In the green area there are 103 sub-districts namely Binjai Barat, Tanah Pinem, Merdeka, Simpang Empat, Kualuh Selatan, Na Ix-X, Stabat, Medan Baru, Padangsidimpuan Utara, Perbaungan, Silau Kahean, Batang Toru, Bajenis, Pulau Rakyat, Batang Kuis, Patumbak, Laubaleng, Tiga Binanga, Rantau Selatan, Sungai Kanan, Marbau, Binjai, Sei Bingai, Medan Maimun, Medan Petisah, Sei Rampah, Padang Hilir, Padang Hulu, Tebing Tinggi Kota, Aek Kuasan, Aek Ledong, Air Batu, Sei Kepayang Barat, Tinggi Raja, Sei Suka, Talawi, Tiga Lingga, Galang, Dolat Rayat, Tigapanah, Bilah Barat, Bilah Hilir, Aek Kuo, Hinai, Pangkalan Susu, Sawit Seberang, Secanggang, Selesai, Medan Deli, Padangsidimpuan Hutaimbaru, Siantar Marimbun, Sei Bamban, Tebingtinggi, Sibolga Sambas, Raya Kahean, Ujung Padang, Datuk Bandar Timur, Rambutan, Aek Songsongan, Bandar Pulau, Buntu Pane, Rahuning, Sei Kepayang, Setia Janji, Silau Laut, Air Putih, Hamparan Perak, Labuhan Deli, Pagar Merbau, Sibolangit, Mardingding, Payung, Panai Tengah,

Kampung Rakyat, Silangkitang, Torgamba, Aek Natas, Bohorok, Kuala, Padang Tualang, Wampu, Panyabungan Utara, Siabu, Medan Kota, Medan Polonia, Barumun, Huta Raja Tinggi, Padang Bolak, Padangsidempuan, Batunadua, Salak, Siantar Barat, Siantar Selatan, Palipi, Dolok

Masihul, Pantai Cermin, Silinda, Tebing Syahbandar, Sibolga Selatan, Bandar Masilam, Dolok Panribuan, Tanjung Balai Selatan, Sipirok, dan Tarutung. If the area is drawn to the district level, it will be in 24 districts/cities as shown in Table 1 part of the green area (cluster 3).



**Figure 1.** Distribution of Clients at the BNN Rehabilitation Center from North Sumatra  
 Source: Processed by Authors, 2020

**Table 1.** Division of drug users clusters undergoing rehabilitation at the BNN Babes Rehab by City / Regency

CLUSTER 1 (Red Area)	CLUSTER 2 (Yellow Area)	CLUSTER 3 (Green Area)
3 District/Ciy	11 District/ City	24 District/City
Deli Serdang	Medan	Asahan
Medan	Karo	Binjai
Binjai	Asahan	Batu Bara
	Labuhan Batu	Dairi
	Deli Serdang	Karo
	Labuhan Batu Utara	Langkat
	Binjai	Labuhan Batu Utara
	Batu Bara	Labuhan Batu Selatan
	Tanjung Bali	Labuhan Batu
	Padangsidempuan	Medan
	Karo	Mandailing Natal
		Padang Sidempuan
		Pakpak Barat
		Padang Lawas Utara
		Padang Always
		Pematang Siantar
		Simalungun
		Sedang berdagai
		Sibolga
		Samosir
		Tebing Tinggi
		Tapanuli Seltan
		Tanjung Balai
		Tapanuli Utara

*Source:* Processed by Authors, 2020

Overall, there are 137 sub-districts in North Sumatra province that have residents accessing drug rehabilitation services at the BNN rehabilitation center in Lido. The entire sub-districts in North Sumatra Province are 444 sub-districts. This means that only 30.8% percent of sub-districts in the North Sumatra region have residents accessing rehabilitation services at the BNN rehabilitation center Lido.

Areas that are included in the red area should receive more attention, but for areas that are yellow and green, there is a possibility that they will become red, therefore handling these areas must be considered. Environmental control is very important because according to the Convergence Theory put forward by William Stern in Walgito (2010) states that nature and experience or the environment have an important role in individual development.

Bandura in Walgito (2010) also states that behavior (B), environment (E), and organisms or person (P) influence one another. Behavior is a function or dependent on the environment and the organism or the person. The person will depend on behavior and environment; Likewise, the environment will depend on behavior and person so that one another influences each other.

Based on data from the National Narcotics Agency in 2019, there are 59 drug-prone areas in the North Sumatra region. The data held by the BNN is informed in writing with the full address. One example of address written in the data issued by is Sei Rotan Village, Kec. Percut Sei Tuan, Kab. Deli. The writing of drug-prone areas is quite clear, but the writing is still not following the naming of the area issued by the Ministry of Home Affairs, so it needs adjustments in the writing to make

it easier to code data. If the data is represented visually using GIS, the illustration will look like in Figure 2.

Based on Figure 2, the distribution of drug-prone areas in North Sumatra is easier to understand compared to written data. This picture shows the drug-prone areas in North Sumatra, spread over 8 districts/cities and 29 sub-districts. The eight districts are Deli Serdang, Medan City, Mandailing Natal, Pematang Siantar, Simalungun, Serdang Bedagai, Tanjung Balai, and Gunung Sitoli. Figure 2 shows that 5 out of 8 drug-prone districts are bordered by beaches, which are Deli Serdang, Medan City, Serdang Bedagai, Mandailing Natal, Gunung Sitoli. An Area bordering the coast is one of the areas prone to drug abuse. After making an spatial analysis for data of the client addresses from North Sumatra attending drug rehabilitation dan the drug porn area, then we do an overlay map, on both of the maps in the district/sub-regional level. The interpreting overlay map, look like Figure 3.

It was found that almost 50% of districts/cities in North Sumatra have drug problems that need attention from the results of the overlay. It is clearly showing that North Sumatra has clients undergoing drug rehabilitation at the BNN, areas that do not have residents undergoing drug rehabilitation at the BNN, areas that are prone to drugs, and areas where clients undergo drug rehabilitation and are areas prone to drugs. Only by looking at one map, we can interpret several phenomena that occur in an area. This is one of the advantages of using a geographic information system.

Seeing Figure 2, we can see a shaded area that shows drug-prone areas. There are red and green shaded areas. The red and shaded areas indicate the number of drug abuse followed by the large number of people accessing rehabilitation services. Although there has been synchronization between abuse and rehabilitation, these areas need improvement in efforts of supply reduction, fever reduction, and

rehabilitation considering these areas are prone areas.

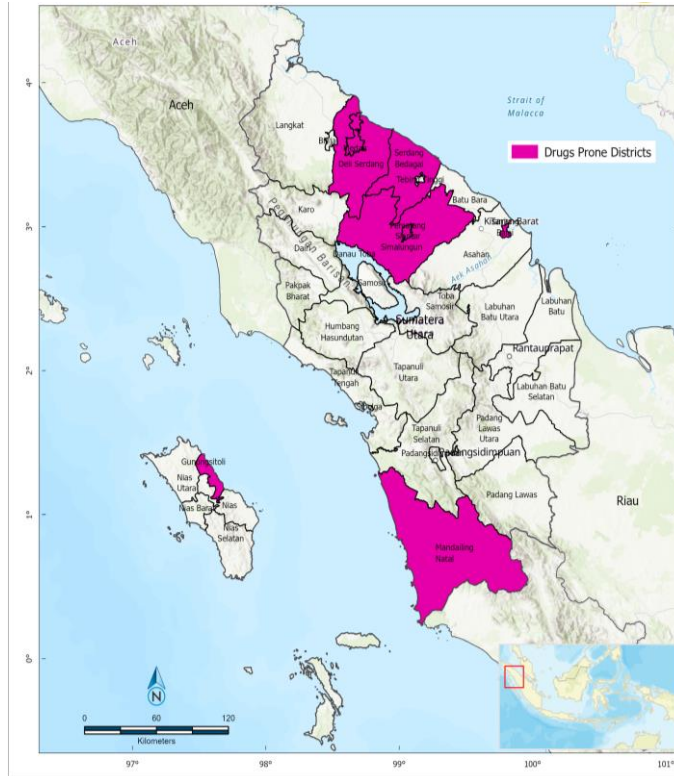
The shaded areas are also in green areas, meaning that in these vulnerable areas there are only 4 people accessing rehabilitation services. This needs to be a concern because at least the population of vulnerable areas has access to rehabilitation. Educational efforts need to be increased regarding the importance of rehabilitation because restoring people who are hooked on drugs will help in efforts to reduce narcotics fever. The green and shaded areas are 4 areas in Mandailing Natal, Pematang Siantar, Simalungun, Serdang Bedagai.

According to the BNN, the drug-prone areas in North Sumatra are spread over 29 sub-districts, 18 (62%) of which are included in the red zone as a result of the spatial analysis of the BNN Rehabilitation Center clients from North Sumatra. This shows that there are still 38% of sub-districts whose residents have not accessed rehabilitation at the BNN Rehabilitation Center. Two areas that are red zones for the spatial analysis of clients of the BNN Rehabilitation Center from North Sumatra are also drug prone areas issued by the BNN, namely Deli Serdang and Medan. Binjai is an area in the red zone for spatial analysis of clients of the BNN Rehabilitation Center but is not included in the list of drug-prone areas.

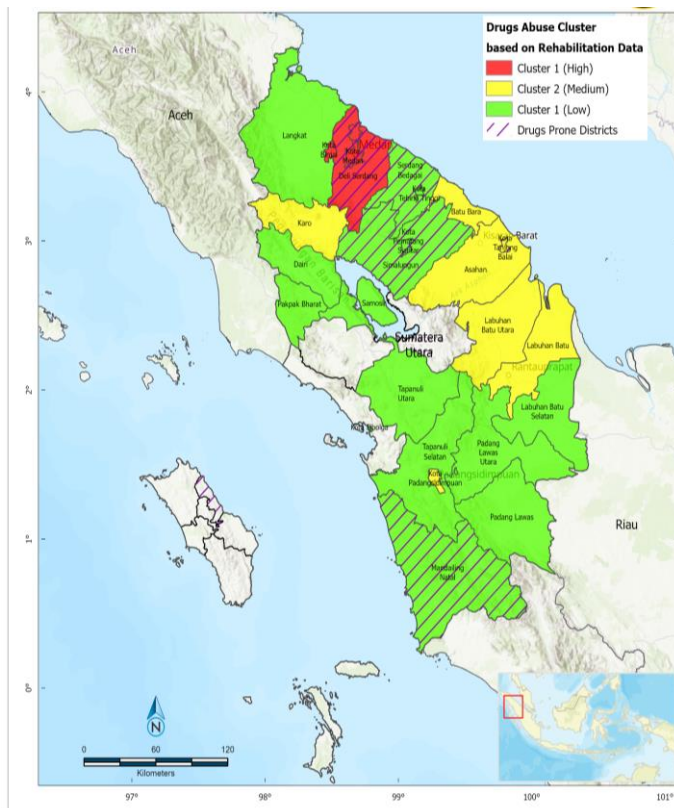
Drug trafficking in the area should be paid more attention and monitored whether there is hidden circulation. Given that many Binjai residents have accessed rehabilitation services at BNN Drug Rehabilitation Centre. There is one area in North Sumatra that is a drug prone area but is not included in the client of the BNN Rehabilitation Center, namely the Gunung Sitoli area. This shows that the awareness of the community in these areas is still lacking in accessing rehabilitation services. The need for increased promotion in education on the importance of rehabilitation needs to be increased.

It is also necessary to make it easy for





**Figure 2.** Drug Prone Area In North Sumatra  
 Source: BNN, 2019a



**Figure 3.** Over lay map of the Distribution of Clients at the BNN Rehabilitation Center from North Sumatra with the Drug Prone Area  
 Source. Processed by Authors, 2020

residents of the area to access rehabilitation facilities, considering that the Mount Sitoli area is located on the island of Nias which requires a long journey to go to the provincial capital.

The Mount Sitoli area is also a Gunning Sitoli area located in a coastal area which also needs more attention because the coastal area is an area that is vulnerable to the entry of narcotics. Isnaini (2018) in her paper about spatial analysis on the impact of socioeconomic Vulnerability to drug abuse prevalence in Indonesia 2015, conclude that areas that are close to borders and free waters are areas that are more vulnerable to drug abuse.

The percentage comparison of the red zone results from the spatial analysis of clients from the rehabilitation center from North Sumatra with drug-prone areas, which reached 62%, shows that there have been preventive, curative, and rehabilitative efforts to prevent the eradication of narcotics abuse and illicit trafficking (P4GN) in drug-prone areas but need more efforts, massively because not all areas in the drug-prone areas have accessed rehabilitation services at the BNN Rehabilitation Center.

Comparing demographic data from the 3 red zones (Deli Serdang, Medan, and Binjai), the three regions have a human development index (HDI) above 73% which is in the high category, the population is more women with a sex ratio above 98, The rate of economic growth is above the average for the North Sumatra region in general, namely  $> 5.3\%$  and there are narcotics crimes. Darandri (2019) in her paper about spatial analysis of the distribution of drug abuse prone areas in Medan city conclude that there is a spatial autocorrelation which shows a group pattern of the distribution of the number of drug abuse cases and the distribution of the ratio of drug abuse cases to the population in the city of Medan.

In those three cities, the population of women is also higher than that of men, although the difference is not too large.

More women population and narcotics crime are the vulnerability of drug abuse. The results of the linear regression test Isnaini et al (2018) state that if the number of male population increases the prevalence of drug abusers will decrease by 0.221, in other words, if there are more women, the prevalence will increase. This is likely because women are more introverted in revealing their status as a drug abuser. An environment with a lot of narcotics crime will also affect drug abuse.

UNODC (2016) states that an environment with social disadvantage creates vulnerability to drug abuse. In the red zone, there are variations in the open unemployment rate, the percentage of poor people, the number of health facilities, and the number of criminal acts. Geographically, the three regions in the red zone are close to each other and include large and most densely populated cities, both in terms of population and economic activity. phenomena that exist in areas that are often close together can affect areas that are nearby too. Seeing these conditions, manage narcotics abuse in one area will affect the closest area. The management must also be careful not to eradicate in one area, but cases in nearby areas have increased. therefore, cultivation should be done as much as possible in the immediate area.

Although false-positive predictions that incorrectly inform the allocation of resources to areas that could attract or encourage crime may occur. But, incorporating exposure to a spatial vulnerability model helps to reduce the effects of false positives by considering the risks that experience with crime present at vulnerable places. This increases the chances that forecasts will be true when suggesting where crime will occur (Silver, 2012). This study presents the empirical place-based assessment of the distribution of the number of drug abuse cases and the distribution of the ratio of drug abuse cases to the population in the city of Medan using GIS.

The availability and sophistication of GIS in recent years has had an impact on the approaches available in the study of health geography and helping them to monitor and respond to health challenges because GIS tools aiding pinpoint cases, identify a spatial trend and disease cluster, correlate a different set of spatial and test statistical hypothesis and mapping the data (Sanders, Aguilar, & Bacon, 2013; Carroll et al., 2014). This study shows that Geographical Information Systems can help in understanding the phenomenon of drug abuse undergoing rehabilitation in the North Sumatra region. Knowing this can help policymakers formulate plans and provide a basis for policy or decision making and can be used as a basis for program monitoring and evaluation.

#### **CONCLUSIONS, RECOMMENDATIONS, AND LIMITATIONS**

The results of the analysis show that Geographic Information System (GIS) technology can be used to make it easier to map drug-prone areas where this is important in efforts to prevent drug abuse and trafficking (P4GN). This also means that a geographic information system can be used to support national defense and security systems. GIS will integrate spatial information with supporting data so that a user will get complete information about spatial and regional conditions

The presentation of the resulting data using maps is more informative than statistical tables. GIS can also help in the understanding phenomenon that is happening in our country, include drug abuse undergoing rehabilitation in the North Sumatra region. Based on the spatial analysis of clients from the center for rehabilitation from North Sumatra in 2017-2018, there are 3 zones, namely red (prone), yellow and green. There are 3 red zones (prone), namely Deli Serdang, Medan, and Binjai with 9 districts namely Percut Sei Tuan, Medan Amplas, Medan Helvetia, Medan Tembung, Medan Perjuangan,

Binjai Utara, Medan Sunggal, Medan Johor, Medan Timur. In the yellow area, there are 25 sub-districts and in the green area, there are 103 sub-districts.

Comparing the drug prone areas in the North Sumatra region issued by the BNN with the red zone spatial analysis of North Sumatran residents who access rehabilitation services at the BNN drug rehabilitation center, showing that 62% of drug prone areas in North Sumatra are also included in the BNN Rehabilitation Center clients from North Sumatra. This shows that there are still 38% of the drug-prone areas in North Sumatra of sub-districts whose residents have not accessed rehabilitation at the BNN Rehabilitation Center. There is even one regency that is in a drug prone area but none of its residents access rehabilitation services at the BNN rehabilitation center. This shows that the awareness of the community in these areas is still lacking in accessing rehabilitation services.

The need for increased promotion in education on the importance of rehabilitation needs to be increased. It is also necessary to make it easy for residents of the area to access rehabilitation facilities. Knowledge of vulnerable areas can help policymakers determine an effective and efficient program that can be used in program evaluation. The obstacle faced is the existence of data that is not recorded with government standards (Ministry of home affairs), so that recording following standards is very important for coding, which will make it easier to analyze. Demographic data are needed down to the village level as well as data standardization that must be prepared by each area so that it is easy to make comparisons.

In optimizing the use of GIS, human resources are required to optimally operate GIS and infrastructure. It is necessary to conduct training to prepare these human resources to support the policy of preventing the eradication of P4GN drug abuse and trafficking. Seeing the difficulty when doing the cleaning data process, the

suggestion for the future is the need to write an address with government standards and the need to fill in the address divided between the names of villages, sub-districts, sub-districts, districts/cities, and provinces. Using geospatial technology, the National Narcotics Agency (BNN) can map which areas are prone to drug use, so that they can prioritize areas for the policy of rehabilitation treatment.

## REFERENCE

- BNN. (2015). *Laporan Kinerja Badan Narkotika Nasional Tahun 2014*. BNN.
- BNN. (2019a). *Indonesia Drug Report 2019*. Puslidan BNN.
- BNN. (2019b). *Uji Publik-Survei Nasional Penyalahgunaan Narkoba di 34 Provnsi*. BNN.Go.Id.
- Boulos, M. N. K. (2004). Towards evidence-based, GIS-driven national spatial health information infrastructure and surveillance services in the United Kingdom. *International Journal of Health Geographics*, 3(1), 1–50.
- Carroll, L. N., Au, A. P., Detwiler, L. T., Fu, T., Painter, I. S., & Abernethy, N. F. (2014). Visualization and analytics tools for infectious disease epidemiology: A systematic review. *Journal of Biomedical Informatics*, 51, 287–298. <https://doi.org/10.1016/j.jbi.2014.04.006>
- Darandri, N. (2019). *Analisis Spasial Sebaran Daerah Rawan Penyalahgunaan Narkoba Di Kota Medan*.
- ESRI. (2016). *GIS Solutions for Urban and Regional Planning Designing and Mapping the Future of Your Community with GIS*. Esri.Com.
- Fazillah, A., Juahir, H., Toriman, E., Mohamad, N., & Mohamad, M. (2018). Combating substance abuse with the potential of geographic information system combining multivariate analysis. *Journal of Fundamental and Applied Sciences*. <https://doi.org/10.4314/jfas.v9i2s.32>
- Hasan, I. (2012). *Pokok-Pokok Materi Metodologi Penelitian dan Aplikasinya*. Ghalia Indonesia.
- Hess, D. R. (2004). Retrospective studies and chart reviews. *Respiratory Care*, 49(10), 1171–1174.
- Isnaini, F., Nitibaskara, T. B. R., & Usman, W. (2018). Spatial analysis on the impact of socioeconomic vulnerability to drug abuse prevalence in Indonesia 2015. *IOP Conference Series: Earth and Environmental Science*, 179, 012005. <https://doi.org/10.1088/1755-1315/179/1/012005>
- Kemenristek RI. (2013). Modul 3: Analisis Spasial. In *Pelatihan Open Sources Software Geodatabase, Web Servis, dan GIS (Model Spasial Open Platform)*.
- Kennedy, L. W., Caplan, J. M., Piza, E. L., & Buccine-Schraeder, H. (2016). Vulnerability and Exposure to Crime: Applying Risk Terrain Modeling to the Study of Assault in Chicago. *Applied Spatial Analysis and Policy*, 9(4), 529–548. <https://doi.org/10.1007/s12061-015-9165-z>
- Mendoza, N. S., Conrow, L., Baldwin, A., & Booth, J. (2013). Using Gis To Describe Risk And Neighborhood-Level Factors Associated With Substance Abuse Treatment Outcomes. *Journal of Community Psychology*, 41(7). <https://doi.org/10.1002/jcop.21572>
- Mennis, J., Stahler, G., & Mason, M. (2016). Risky Substance Use Environments and Addiction: A New Frontier for Environmental Justice Research. *International Journal of Environmental Research and Public Health*, 13(6), 607. <https://doi.org/10.3390/ijerph13060607>
- Pereira, S. M., Ambrosano, G. M. B.,

- Cortellazzi, K. L., Tagliaferro, E. P. S., Vettorazzi, C. A., Ferraz, S. F. B., Meneghim, M. C., & Pereira, A. C. (2010). Geographic Information Systems (GIS) in Assessing Dental Health. *International Journal of Environmental Research and Public Health*, 7(5), 2423–2436. <https://doi.org/10.3390/ijerph7052423>
- Powell, J. T., & Sweeting, M. J. (2015). Retrospective Studies. *European Society for Vascular Surgery*, 50(5), 675. <https://doi.org/10.1016/j.ejvs.2015.07.005>
- Sadahiro, Y. (2006). *Course #716-26 Advanced Urban Analysis E. Lecture Title: Chapter 6 Spatial Analysis*. Associate professor of the Department of Urban Engineering. University of Tokyo. Ua.t.u-Tokyo.Ac.Jp.
- Sanders, L. J., Aguilar, G. D., & Bacon, C. J. (2013). A spatial analysis of the geographic distribution of musculoskeletal and general practice healthcare clinics in Auckland, New Zealand. *Applied Geography*, 44, 69–78. <https://doi.org/10.1016/j.apgeog.2013.07.014>
- Sandi, A. (2016). *Narkoba dari Tapal Batas Negara*. Mujahidin Press Bandung.
- Silver, N. (2012). *The Signal and the Noise: Why So Many Predictions Fail but Some Don't*. Penguin.
- Srivastava, A., Nagpal, B. N., Joshi, P. L., Paliwal, J. C., & Dash, A. P. (2009). Identification of malaria hot spots for focused intervention in tribal state of India: A GIS based approach. *International Journal of Health Geographics*. <https://doi.org/10.1186/1476-072X-8-30>
- Usman. (2003). *Daya Tahan Bangsa*. Program Studi Pengkajian Ketahanan Nasional Program Pascasarjana Universitas Indonesia.
- Walgito, B. (2010). *Pengantar Psikologi Umum*. Andi Offset.