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Spatial Analysis of Narcotics Abuse Based on Knowledge, Socio-Demographics, Social Environment, and Swamp Land

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Abstract

Narcotics abuse is a serious issue that affects public health and social stability, making it crucial to understand the factors contributing to this phenomenon. This study aims to analyze narcotics abuse based on knowledge, socio-demographics, social environment, and swamp land characteristics. The research was conducted in Palembang, the capital of South Sumatra Province, which has diverse geographical and socio-economic characteristics. Palembang is one of Indonesia's major cities with a relatively high population density, featuring various areas interconnected by river networks and swamp lands. The sample consists of 100 narcotics-related cases. Using spatial analysis methods, the respondent data were grouped into low, medium, and high categories for each variable. The results indicate that areas with low knowledge and education, as well as a negative social environment, have higher rates of narcotics abuse. Conversely, areas with balanced characteristics in these aspects tend to have a lower risk of abuse. Additionally, swamp land characteristics also contribute to the level of narcotics abuse. These findings highlight the need for targeted interventions, including educational programs and community strengthening, to reduce the risk of narcotics abuse. This study provides important insights for developing more effective policies in combating narcotics abuse in society.

Keywords: *Spatial Analysis, Narcotics Abuse, Knowledge, Socio-Demographics, Social Environment, and Swamp Land.*

Introduction

Narcotics abuse is one of the serious threats that has a wide-ranging impact on social, economic, and public health aspects. Various factors contribute to the rise in narcotics abuse, including public knowledge, education, income, environmental characteristics, and social dynamics. In this context, mapping using Geographic Information System (GIS) offers an innovative approach to identify the relationships between these factors and the patterns of narcotics abuse in a region. Through GIS mapping, spatial data can be analyzed comprehensively, enabling more effective evidence-based decision-making in narcotics prevention efforts.

Public knowledge about the dangers of narcotics plays a crucial role in preventing and reducing narcotics abuse. A low level of knowledge is often linked to increased vulnerability to drug abuse (Utami, 2021). By mapping the level of public knowledge in a specific area, particularly in high-risk regions, such as those with high rates of narcotics abuse, we can better understand the correlation between knowledge levels and the distribution patterns of narcotics. This approach provides valuable insights into how knowledge gaps may influence drug-related risks and helps in designing targeted interventions for prevention.

In addition to knowledge, socio-demographic factors such as education level also influence narcotics abuse. Areas with lower education levels often show higher rates of narcotics abuse. Better education provides communities with greater access to information about the dangers of narcotics and enhances their ability to make more informed decisions (Simatupang, 2022). By using GIS, the distribution patterns of narcotics can be analyzed alongside educational data, providing a comprehensive view of regions that are vulnerable to narcotics abuse based on education levels. This approach helps in identifying at-risk areas and enables the development of targeted prevention strategies.

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In addition to education, socio-demographic factors such as employment also influence narcotics abuse. Socio-demographics, including employment, play a crucial role in shaping the likelihood of narcotics abuse. Education levels and types of employment are often closely linked to an individual's access to the information and resources necessary to prevent substance abuse. Individuals working in unstable sectors or with low incomes may face greater economic and social pressures, increasing their risk of turning to narcotics as a means to cope with stress or life challenges (Šileika & Bekerytė, 2013). Furthermore, unhealthy work environments or exposure to peers who use narcotics can also contribute to substance abuse behaviors, highlighting the importance of understanding employment characteristics in prevention and intervention efforts. Mapping these factors using tools like GIS can help pinpoint areas where such risks are higher, allowing for more targeted solutions.

Socio-demographic factors such as income also play a role in determining patterns of narcotics abuse. In several studies, low-income communities tend to be more vulnerable to substance abuse due to limited access to healthcare, education, and information (Roshanpajouh et al., 2020). By using GIS mapping, income data can be correlated with narcotics abuse data, providing a clear visualization of high-risk areas based on the economic conditions of the population. This approach can aid in designing more targeted interventions, focusing on addressing the underlying economic challenges that contribute to the vulnerability of these communities to narcotics abuse.

In addition to socio-demographic factors, land characteristics such as swamp areas in certain regions also significantly influence narcotics abuse. Remote and difficult-to-access swamp lands are often used as drug distribution routes, as these areas are harder to monitor (Razali et al., 2023). GIS can map regions with swamp land characteristics to examine the relationship between geographical conditions and narcotics abuse patterns, aiding authorities in identifying areas that require more intensive surveillance. This spatial analysis can help in directing resources and strategies to mitigate the use of these areas for illegal drug activities, ultimately contributing to more effective prevention efforts.

The social environment also plays a significant role in shaping narcotics abuse patterns. Factors such as involvement in certain social groups, social pressure, and interpersonal relationships can influence the spread of narcotics within a community (Rapier et al., 2019). By mapping the social environment using GIS, we can explore the relationship between social dynamics and narcotics distribution patterns in a specific area, and identify high-risk groups. This approach allows for a deeper understanding of how social influences contribute to drug abuse, enabling more effective, targeted interventions to reduce the impact of narcotics in vulnerable communities.

By employing a GIS approach, various factors influencing narcotics abuse—including knowledge, education, employment, income, social environment, and swamp land characteristics—can be analyzed spatially. This provides a deeper understanding of the interactions between these factors and narcotics abuse, aiding in the design of more effective, data-driven prevention policies and strategies. This study aims to interpret data with geographical components to identify narcotics abuse based on knowledge, education, employment, income, social environment, and swamp land characteristics in a region using GIS.

The research is conducted in Palembang, the capital of South Sumatra Province, which has diverse geographical and socio-economic characteristics. Palembang is one of Indonesia's major cities with a relatively high population density, featuring various areas interconnected by river networks and swamp lands. The extensive and hard-to-access swamp areas in some parts of the city are often exploited as drug distribution routes that are difficult for law enforcement to monitor. Additionally, Palembang exhibits complex social dynamics, including regions with varying education and income levels, along with social environments that are prone to narcotics spread. Therefore, selecting Palembang as the research location is highly relevant for mapping and analyzing the factors influencing narcotics abuse, focusing on the impacts of knowledge, education, income, swamp land characteristics, and social environment.

Method

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The type of research used is descriptive analytical survey with a cross-sectional study approach. The sample in this study consists of narcotics-related detainees from December 2023, totaling 100 cases. The samples were obtained from five police stations with the highest narcotics cases in Palembang: Polsek Ilir Barat 2, Ilir Timur 2, Seberang Ulu 1, Gandus, and Sukarami. The samples were recorded based on their residential locations.

This research utilized a 62s model Global Positioning System (GPS) to collect primary data, specifically the coordinate points corresponding to the respondents' addresses. Spatial analysis was conducted using ArcGIS 10.3, along with various maps obtained for the study. Regional analysis employed overlay techniques, specifically the Weighted Overlay or Multi-Criteria Overlay approach in a quantitative manner. The distribution of respondents is presented in percentages, processed using the natural break method in ArcGIS.

Result and Discussion

General Overview of Palembang City

Palembang is divided by the Musi River into two regions: Seberang Ilir and Seberang Ulu (Hidayat et al., 2022). Located between 2°52'–3°5' South Latitude and 1°4°37'–1°4°52' East Longitude, Palembang experiences a tropical climate with relatively humid winds. The temperature ranges from 23.4°C to 31.7°C, with the highest rainfall occurring in April at 338 mm, and the lowest in September at 10 mm. The terrain is relatively flat, with slightly elevated areas in the northern part of the city. Much of the land is prone to flooding during or after continuous rain, with an average elevation of 8 meters above sea level. Geographically, 54 percent of Palembang's area consists of swamp land, and urban development has led to some swamp reclamation.

Palembang is the capital of South Sumatra Province, comprising eighteen districts: Ilir Timur I, Ilir Timur II, Ilir Timur III, Ilir Barat I, Ilir Barat II, Seberang Ulu I, Seberang Ulu II, Jakabaring, Sukarame, Sako, Bukit Kecil, Gandus, Kemuning, Kalidoni, Plaju, Kertapati, Alang-Alang Lebar, and Sematang Borang.

Several areas in Palembang consist of swamp land, including Ilir Barat II: This area has extensive swamp land close to the Musi River, typically used for agriculture and residential purposes. Seberang Ulu I: Also characterized by significant swamp land, this district is located near the Musi and Ogan Rivers. Ilir Timur II: This area features substantial swamp land adjacent to several small rivers. Sukarami: Similar to the other districts, Sukarami contains extensive swamp land around the Musi and Ogan Rivers. Gandus: This district also has considerable swamp land close to the Musi River, primarily utilized for agriculture and housing.

Spatial Analysis

Data interpretation from the research results in the form of maps can provide a clearer picture of the findings. In the mapping of the research results, the distribution of narcotics abuse is illustrated based on knowledge, education, employment, income, social environment, and swamp land. The distribution of respondents is presented in percentages, with data processed using the natural break method in ArcGIS, as shown in Table 1.

Table 1. Percentage of Respondents' Data

Category	Percentage		
	Low	Medium	High
Knowledge Distribution Map	0-4.65	4.65-16.28	16.28-30.23
Education Distribution Map	0-2.7	2.7-8.11	8.11-29.73
Job Distribution Map	0-5.56	5.56-16.67	16.67-38.89
Income Distribution Map	0-5.08	5.08-15.25	15.25-27.12
Social Environment Map	0-2.47	2.47-8.64	8.64-18.52

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Swamp Land Characteristics Map	0-2	2-14	14-28
Distribution Narcotics Abuse	1-5	5-10	10-20

Source: Data Processing (2024)

The natural breaks method in ArcGIS is employed to classify the distribution of respondents in percentages by identifying patterns or clusters based on the natural distribution of values within the dataset. This method produces more meaningful and relevant classes, as they are formed based on significant differences in the data, avoiding distortions caused by arbitrary divisions that do not reflect the actual conditions. The resulting map becomes easier to interpret, with colors or symbols that highlight differences in the distribution of respondents, thereby facilitating visual analysis.

By displaying data in percentages, this mapping technique provides a clear overview of the proportion of respondents within each category. This approach supports direct comparisons between different areas or groups, enabling better location-based decision-making. Through visual cues, stakeholders can easily identify regions with higher or lower percentages, enhancing the understanding of spatial patterns and trends related to respondent distribution.

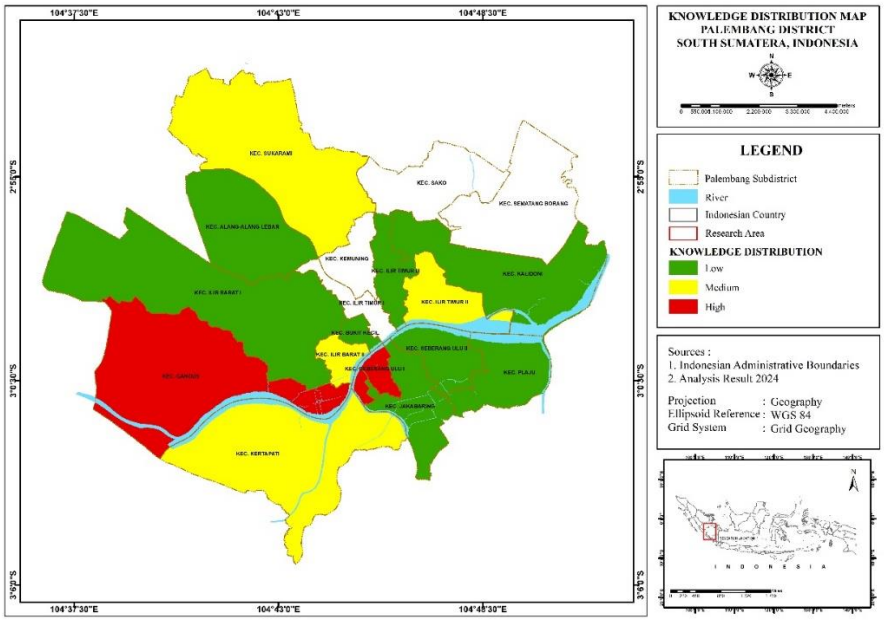

Figure 1. Distribution Map of Respondents Based on Knowledge

Source: Data Processing (2024)

This map illustrates the distribution of respondents based on knowledge in three categories: low, medium, and high. The classification of areas is based on the dominance of respondents' knowledge in each region:

Areas with Low Knowledge Distribution: This area is marked by a majority of respondents having a low level of knowledge compared to those with medium or high knowledge. This indicates that education and socialization related to the topic under study still need to be improved in these areas, specifically in Gandus District and Seberang Ulu 1 District.

Areas with Medium Knowledge Distribution: This area has a balanced number of respondents with low and high knowledge levels. It is considered a transitional area, where efforts to enhance community knowledge will be more effective due to the balance among various levels of knowledge.

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Areas with High Knowledge Distribution: This area is characterized by a majority of respondents with a high level of knowledge. These areas can serve as examples of successful education programs or interventions that have increased community awareness and understanding of the issues being studied.

Using this map, we can identify areas that require more attention in terms of education and socialization, as well as regions that already have a good understanding, allowing for more targeted interventions. With a good knowledge of narcotics, individuals can make informed decisions, understand the associated health and legal risks, thereby reducing the desire to experiment with or use narcotics (Lee et al., 2024). A well-informed community is also more likely to support strict prevention policies and actions, creating political pressure for the enforcement of harsher penalties against illegal substance abusers.

Knowledge has a significant impact on substance abuse, as understanding the dangers and negative effects can prevent young people from becoming involved in drug use and trafficking. Efforts to increase knowledge about narcotics among youth are a crucial first step in prevention. Good knowledge also helps young people recognize signs of substance abuse and avoid related activities (Victor et al., 2019). Effective drug education programs equip the younger generation with the knowledge to prevent them from falling into substance abuse, serving as a long-term preventive measure. A community aware of the negative impacts of narcotics is more actively engaged in supporting efforts to address this issue, including dismantling related criminal networks (Nawi et al., 2021).

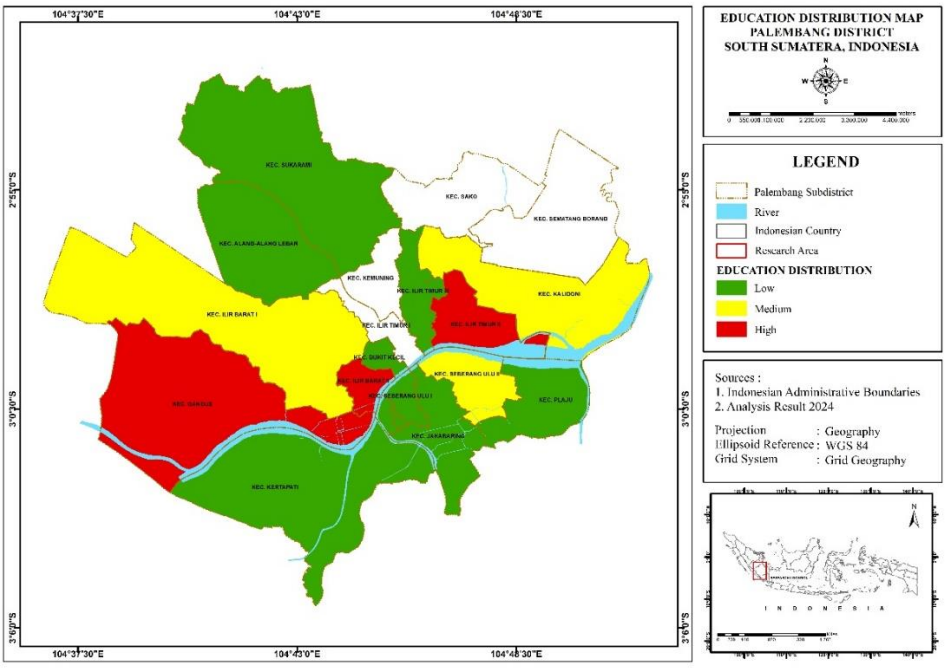

Figure 2. Distribution Map of Respondents Based on Education

Source: Data Processing (2024)

This map shows the distribution of respondents' education, divided into three categories based on educational attainment: low, medium, and high. The categorization of areas is determined by the dominance of respondents with specific education levels:

Areas with Low Education Distribution: This area is dominated by respondents with a basic education background or below. This indicates the need for programs to improve access to and the quality of education to enhance the educational level of the community in these areas, specifically in Gandus District, Ilir Barat 2 District, and Ilir Timur 2 District.

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Areas with Medium Education Distribution: This area has a balance between the number of respondents with low and high education levels. This shows a relatively balanced variation in education levels in this area, with significant potential for improving access to higher education.

Areas with High Education Distribution: This area is dominated by respondents with upper secondary education to higher education. This area can be considered more advanced in terms of access to and participation in education and can serve as a reference for developing educational policies in other regions.

This mapping helps visualize the distribution of education across various regions, enabling the government and other stakeholders to design more focused and needs-based education improvement programs in each area. Higher education levels can also open up access to alternatives, such as talent or interest development, which can divert individuals' attention from drug use. Quality education enhances the overall quality of life (Erlyn et al., 2022). The government has invested in infrastructure spending, including school construction (Hidayat et al., 2024).

Higher education helps individuals understand the potential legal consequences of using or abusing narcotics and raises community awareness about the associated dangers and risks (Hussein et al., 2022)(Nawi et al., 2021). When individuals recognize the negative impacts of narcotics, they are more likely to avoid them (Wulandari & Hartati, 2020). Conversely, low education levels often result in individuals being less informed about narcotics, diminishing their knowledge of how to refuse offers of drugs (Traum & Fiorentine, 2021). A lack of access to quality education increases the risk of involvement in harmful activities, such as drug use or trafficking.

Several patterns of substance abuse have been found to be closely linked to lower socioeconomic status and lower parental education levels (Gerra et al., 2020). Education also plays a significant role in shaping an individual's mindset and behavior within society. The higher a person's education, the more developed their critical thinking skills tend to be (Martzoukou et al., 2020). Therefore, individuals with lower education levels may be more inclined to engage in deviant behaviors (Albakova et al., 2020).

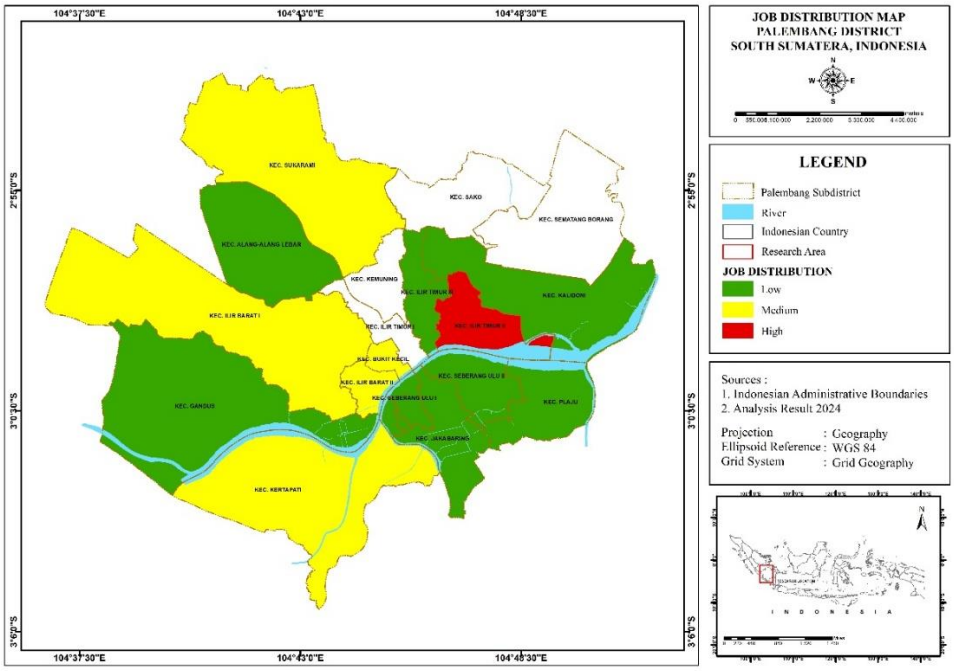

Figure 3. Distribution Map of Respondents Based on Employment

Source: data processing (2024)

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This map provides an overview of the distribution of respondents' employment, grouped into three categories: formal sector, informal sector, and unemployed. Each area is classified based on the dominance of the types of employment held by respondents in that region:

Areas with Low Employment Distribution: This area has a significant number of respondents who are unemployed, either due to being inactive in the labor market or not seeking employment. This area requires intervention in the form of skills training and job creation programs, specifically in Ilir Timur 2 District.

Areas with Medium Employment Distribution: This area has a balance between the number of respondents who are employed and those who are not. This area requires skills training programs and improved access to job opportunities to maximize the potential of respondents in this region.

Areas with High Employment Distribution: This area is dominated by respondents working in the informal sector, such as small traders, casual laborers, or self-employed individuals without legal entities. This area needs more attention regarding access to economic assistance programs and entrepreneurship empowerment.

By understanding the pattern of job distribution, policies can be developed to address specific needs in each region, either through increasing access to formal employment, empowering the informal sector, or job training programmes for the unemployed. Programme implementation can be done by providing training for communities on water hyacinth processing techniques into value-added products, whether for handicrafts, papermaking, or biogas production (Yuliana et al., 2021). In addition to water hyacinth, another potential of swamp land is river mussels known as mussels and river snails, which are commonly known as gondang, which can be processed into local food typical of the Musi river area which has economic value by making it into shredded or chips (Erlyn et al., 2023).

Not having a permanent job and having low education are characteristics involved in narcotic drug abuse (Demir et al., 2022). Meanwhile, school failure and socioeconomic status predict drug abuse in adolescents and young adults (Gauffin et al., 2013). A factor that plays a role in causing drug abuse is not having a job (Grillo et al., 2021). n addition, findings linking knowledge, poverty, unemployment and crime underline the strong relationship between these three aspects (Cheteni et al., 2018; Desmond & Western, 2018; İsmail et al., 2023; Wijaya, 2011).

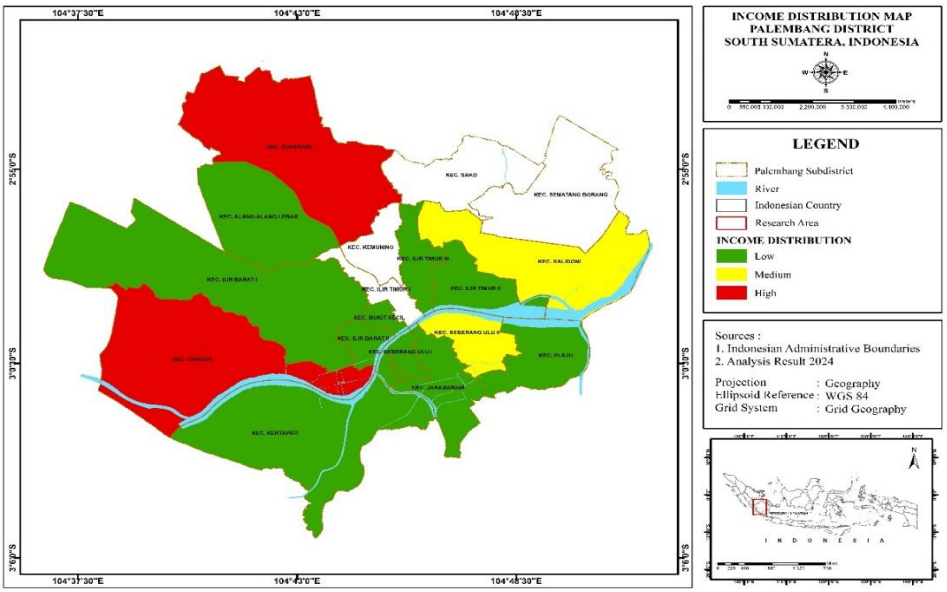

Figure 4. Distribution Map of Respondents Based on Income

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This map visualizes the distribution of respondents' income levels, grouped into three categories: low, medium, and high income. The categorization of areas is determined based on the dominance of respondents' income levels in each region:

Areas with Low Income Distribution: This area is dominated by respondents with low income, which is generally associated with employment in the informal or unstable sectors. This area may require economic empowerment programs and access to more stable income opportunities, specifically in Gandus District and Sukarami District.

Areas with Medium Income Distribution: In this area, the number of respondents with medium income tends to be more evenly distributed compared to those with low or high income. This area indicates a balance in the economic levels of the community, with significant potential for improving living standards if supported by appropriate economic policies.

Areas with High Income Distribution: This area is dominated by respondents with high income. This area can be considered economically established and could be a focus for investment or innovation development.

This map helps to identify areas that require economic intervention according to people's income conditions, so that policies can be directed towards reducing economic inequality between areas. Low income due to unemployment and poverty has an influence on criminal behaviour. The tendency of people with low socio-economic levels to participate in criminal behaviour is due to their life experiences. This leads them to have an attitude of committing crime (Desmond & Western, 2018). In addition, people with low income levels are more susceptible to drug influence as they seek ways to overcome their financial difficulties. Understanding the socio-demographic factors that influence the risk of engaging in drug abuse can help in designing more effective and targeted prevention programmes (Victor et al., 2019).

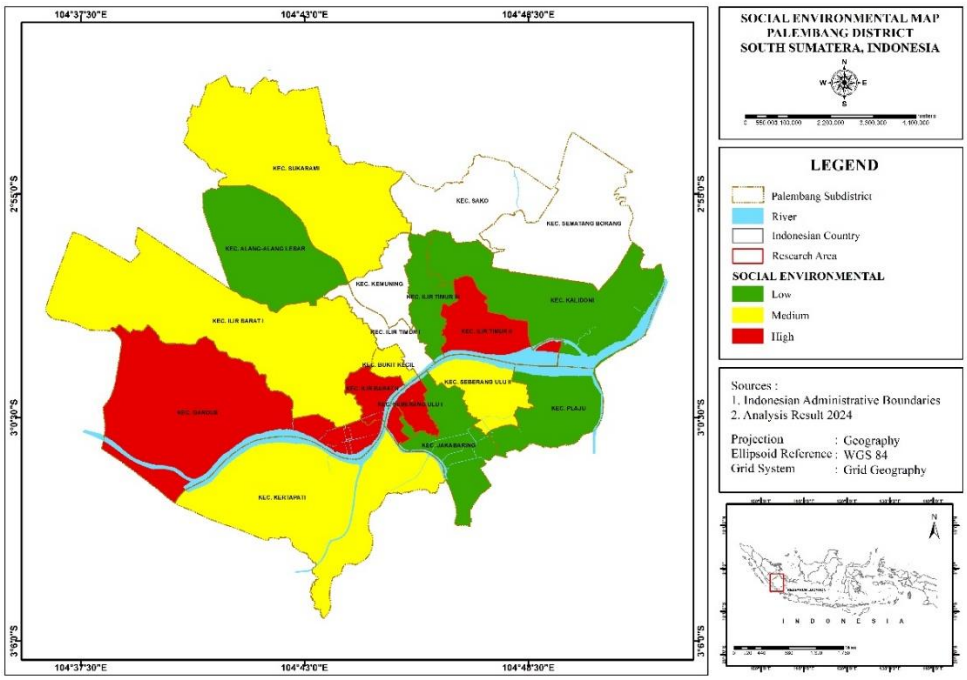

Figure 5. Distribution Map of Respondents Based on Social Environment

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This map illustrates the distribution of respondents' social environment, divided into three categories: less supportive, neutral, and supportive. Each area is categorized based on the dominance of respondents who perceive their social environment as having a certain influence on their behavior and daily life.

Areas with Low Social Environment Distribution: This area is dominated by respondents who feel their social environment is negative or less supportive, whether in terms of social relationships, security levels, or moral support. This area may require community strengthening programs and initiatives to enhance a sense of togetherness to create a more conducive environment, specifically in Gandus District, Ilir Barat 2 District, Seberang Ulu 1 District, and Ilir Timur 2 District.

Areas with Medium Social Environment Distribution: This area shows a balance between respondents who feel their environment is supportive and those who feel it is less supportive. This area could be a focus for developing initiatives that strengthen social interactions and increase community participation.

Areas with High Social Environment Distribution: In this area, the majority of respondents report that their social environment is positive or very supportive, both in terms of interpersonal relationships and in providing a sense of safety and comfort. This area can serve as an example for replicating social programs in other regions.

By mapping the condition of the social environment, governments and stakeholders can design appropriate policies to improve the quality of social interactions, thereby creating a more harmonious environment and supporting community well-being. Neighbourhoods with high levels of drug crime increase the risk of adolescent and young adult drug abuse (Gauffin et al., 2013). Positive social environments, such as supportive family and friends, provide important emotional and social support that helps individuals cope with pressure or stress that may trigger drug use, as well as providing healthy alternatives to social activities (Enssle & Kabisch, 2020). When peers engage in drug use, individuals tend to feel that they need to participate in this activity to maintain or gain social acceptance from their group (Mason et al., 2004). Before getting into drugs, it starts with a friendship that invites alcohol consumption (Diclemente, 2017).

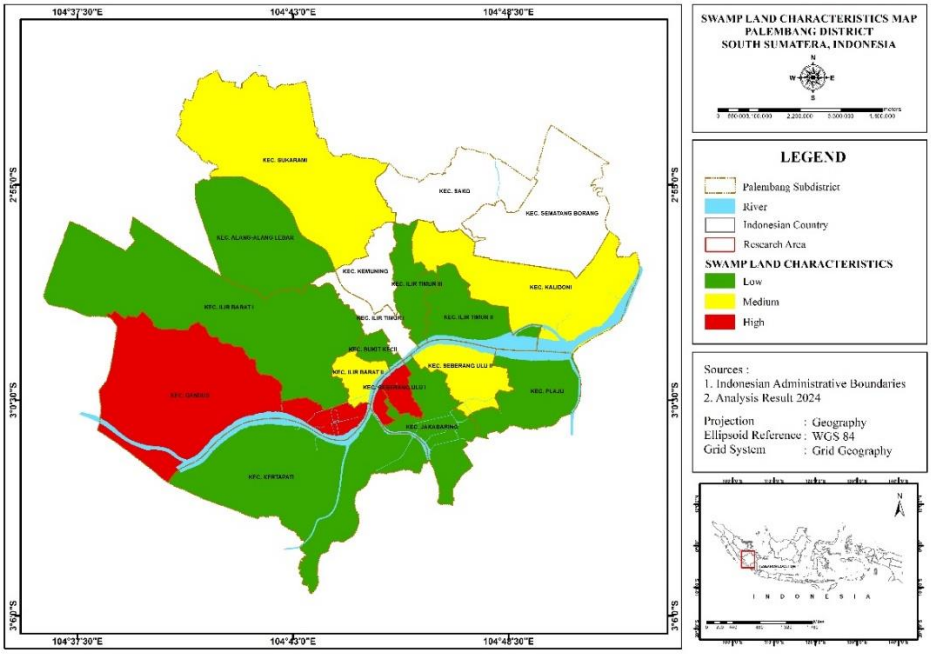

Figure 6. Distribution Map of Respondents Based on Wetland Characteristics

Source: Data Processing (2024)

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This map outlines the characteristics of wetlands in the areas where respondents reside, divided into three categories: shallow, medium, and deep wetlands. These categories are based on depth, drainage conditions, and the nature of the land in each area.

Areas with Low Wetland Characteristics: The low category indicates that most of the land in this area is not wetland, with only a few areas classified as shallow wetlands. In these areas, water typically does not remain stagnant for long, allowing for easier adaptation to daily activities. This region often has higher agricultural potential compared to other wetland areas.

Areas with Medium Wetland Characteristics: The medium category shows a balance between shallow wetland and non-wetland areas, creating potential for diverse management. This area often experiences seasonal flooding but can still be utilized for activities such as agriculture or aquaculture. Integrated management is needed to consider the balance between wetland and non-wetland areas, along with improvements to drainage infrastructure to maximize the potential of both land types.

Areas with High Wetland Characteristics: In this area, shallow wetlands dominate, with prolonged waterlogging that is difficult to manage. This area requires significant interventions in terms of drainage, resource management, and environmental policies, specifically in Gandus District and Seberang Ulu 1 District.

The mapping helps identify the physical characteristics of the land where respondents live, which can be used as a basis for designing effective swampland adaptation and management strategies in different regions. Regional characteristics can influence drug abuse. Isolated or remote areas can be more vulnerable to illicit drug abuse due to a lack of surveillance and access to prevention resources (Rahman et al., 2024). In addition, areas that have high poverty rates or high unemployment rates may also increase the risk of engaging in illicit drug abuse as individuals may seek ways to overcome their financial difficulties (Nirmalasary et al., 2024).

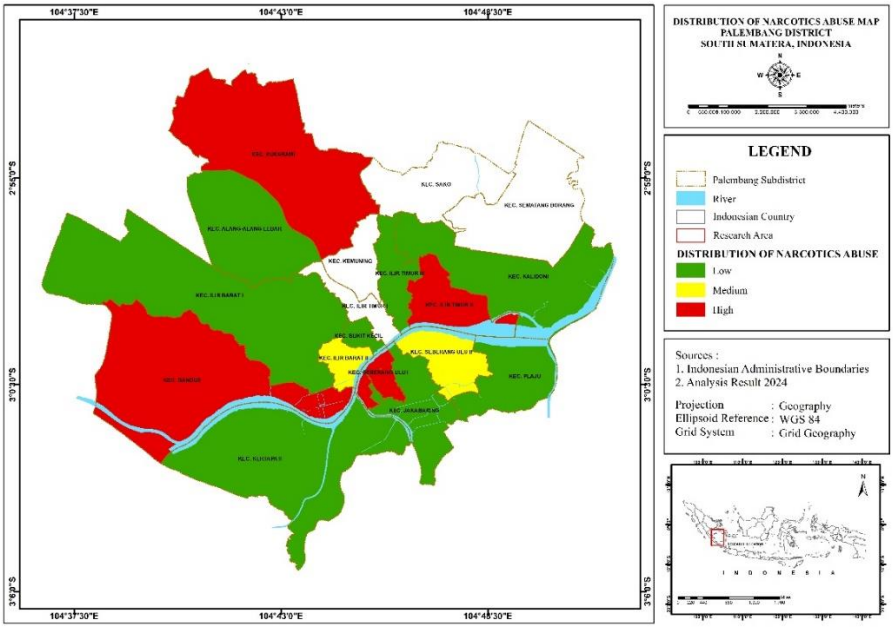

Figure 7. Distribution Map of Respondents' Substance Abuse Based on Knowledge, Education, Employment, Income, Social Environment, and Wetland Characteristics

Source: Data Processing (2024)

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This map presents the distribution of substance abuse among respondents, categorized into three levels: low, medium, and high. These categories are determined based on GIS overlay analysis of variables such as knowledge, education, employment, income, social environment, and wetland characteristics.

Areas with Low Substance Abuse Distribution: In this area, respondents demonstrate a low level of substance abuse. Factors such as higher education, good knowledge of the risks of substance abuse, and a supportive social environment contribute to minimal abuse levels. This area also has better income and stable employment, along with land characteristics that pose little risk.

Areas with Medium Substance Abuse Distribution: This area shows a medium level of substance abuse, with some respondents exposed to risks. Despite having adequate knowledge and education, factors such as informal employment, fluctuating income, and a less supportive social environment increase the potential for substance abuse. The wetland characteristics in this area may also contribute, creating more vulnerable conditions.

Areas with High Substance Abuse Distribution: This area is dominated by high levels of substance abuse, specifically in Gandus District, Seberang Ulu 1 District, Ilir Timur 2 District, and Sukarami District. Factors such as low education, minimal knowledge about the dangers of substance abuse, and a negative social environment heavily influence this situation. Unstable employment and low income also contribute to a higher risk of substance abuse, compounded by wetland characteristics that may create more challenging conditions to address.

This map provides insight into the relationship between various variables and drug abuse, enabling the development of more effective and focused intervention programmes according to the characteristics of each region. Higher education can help individuals develop better decision-making skills (Raharni et al., 2022). They can evaluate the risks and benefits of drug use more wisely, and may be better able to avoid peer pressure or potentially dangerous situations. Higher education often opens the door to better and more stable employment opportunities. People who have adequate employment and positive career prospects are less likely to be tempted to engage in drug abuse, which can undermine their employment opportunities (Zaidi, 2020).

Often, the level of knowledge about drugs is closely related to a person's level of education (Traum & Fiorentine, 2021). ndividuals with low levels of education are less exposed to information about drugs and their negative impacts, which in turn may reduce their knowledge of how to avoid or refuse drug offers. This may be because lack of access to quality education can increase the likelihood of individuals engaging in harmful activities such as drug use or sale.

Narcotics abuse is a complex problem and not only dependent on certain types of ecosystems. Urban areas or areas with high levels of poverty often have higher rates of drug abuse. Factors such as accessibility, social environment, and neighbourhood pressures can influence drug abuse rates (Ezell et al., 2021).

Regional characteristics can influence drug abuse. Isolated or remote areas can be more vulnerable to illicit drug abuse due to a lack of surveillance and access to prevention resources (Cheteni et al., 2018). In addition, areas that have high poverty rates or high unemployment rates may also increase the risk of engaging in illicit drug abuse as individuals may seek ways to overcome their financial difficulties.

Conclusion

Spatial analysis of narcotics abuse based on knowledge, socio-demographics, social environment, and swamp land characteristics reveals a complex relationship between these factors and the level of narcotics abuse in various regions. By categorizing respondents based on education, employment, income, and social environmental conditions, as well as identifying swamp land characteristics, a better understanding of the potential risks of narcotics abuse can be achieved. Areas with low knowledge, inadequate education, and negative social environments demonstrate higher rates of abuse, while regions with a more balanced profile in these characteristics are likely to have lower abuse potential. These findings underscore the need for

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targeted interventions, including educational programs and community empowerment initiatives, to effectively reduce the risk of narcotics abuse.

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