

## Cannabis Abuse in Indonesia : A Psycho-Socio-Cultural Analysis

Maria Adelia Samantha<sup>1</sup>, Erlita Christiana<sup>2</sup>, Ananta Yudiarso<sup>3\*</sup>

<sup>123</sup>*Department of Psychology, University of Surabaya*

Corresponding author:

Ananta Yudiarso  
[ananta@staff.ubaya.ac.id](mailto:ananta@staff.ubaya.ac.id)

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### Abstract

**Background:** Cannabis abuse in Indonesia is a multidimensional issue shaped by psychological, sociological, cultural, and socioeconomic factors. **Objective:** This study examines the effects of Provincial Minimum Wage, population density, and socioeconomic characteristics on cannabis abuse through psychological, sociological, and anthropological perspectives. **Method:** A mixed-methods design combined a systematic literature review, machine-learning analysis of provincial secondary data from Statistics Indonesia (BPS), and semi-structured interviews with three participants for contextual explanation rather than statistical generalization. Decision Tree, Random Forest, Support Vector Machine, and Neural Network models were used to identify key predictors. **Results:** Provincial Minimum Wage and population density consistently emerged as the most influential predictors, while interviews showed how economic pressure, social environment, and cultural values shape cannabis-related behaviours. **Conclusion:** Cannabis abuse reflects interactions among structural, psychological, and sociocultural factors. Integrating machine learning with qualitative inquiry offers a more comprehensive understanding and supports future prevention and intervention strategies.

**Keywords:** Canabis abuse; risk factors; usage trends

### Abstrak

**Latar Belakang:** Penyalahgunaan ganja di Indonesia merupakan isu multidimensional yang dipengaruhi faktor psikologis, sosiologis, budaya, dan sosial ekonomi. **Tujuan:** Penelitian ini mengkaji pengaruh Upah Minimum Provinsi (UMP), kepadatan penduduk, dan karakteristik sosial ekonomi terhadap penyalahgunaan ganja melalui perspektif psikologis, sosiologis, dan antropologis. **Metode:** Penelitian menggunakan metode campuran yang menggabungkan tinjauan pustaka sistematis, analisis data sekunder provinsi dari Badan Pusat Statistik (BPS) dengan pembelajaran mesin, serta wawancara semi-terstruktur terhadap tiga partisipan untuk memberikan penjelasan kontekstual. Empat algoritma, yaitu Decision Tree, Random Forest, Support Vector Machine, dan Neural Network, digunakan untuk mengidentifikasi prediktor utama. **Hasil:** Olah data menunjukkan bahwa UMP dan kepadatan penduduk merupakan prediktor paling berpengaruh, sedangkan wawancara mengungkap peran tekanan ekonomi, lingkungan sosial, dan nilai budaya dalam membentuk perilaku terkait ganja. **Kesimpulan:** Temuan ini menegaskan bahwa penyalahgunaan ganja berkaitan dengan interaksi faktor struktural, psikologis, dan sosiokultural. Integrasi pembelajaran mesin dan penelitian kualitatif memberikan pemahaman yang lebih komprehensif serta mendukung pengembangan strategi pencegahan dan intervensi.

**Kata Kunci:** Faktor risiko; Penyalahgunaan ganja; Tren penggunaan.

## Introduction

Cannabis abuse has become an increasingly complex public health and social issue worldwide, with consequences extending beyond individual health to social, economic, and cultural domains. Although cannabis is widely recognized for its psychoactive effects and therapeutic potential in some countries, its misuse remains associated with impaired psychological functioning, reduced educational attainment, criminal behaviour, and broader social problems (Connor et al., 2021; Feingold et al., 2021). In Indonesia, cannabis remains the most frequently abused illicit drug after methamphetamine, making it an important issue requiring multidisciplinary investigation. Drug abuse has been a global issue that increases every year and becomes a serious threat for the community. The numbers gathered by the Central Statistics Agency (BPS) in Indonesia showed a significant increase in the usage of all kinds of narcotics. This increase indicates that there are underlying factors that contribute to drug use, including the influence of the social environment, psychological pressure, and weak family and community supervision (Aldino, 2018; Helviza et al., 2016). As a worldwide matter, cannabis (also called as marijuana) has been ranked the third most commonly used substance, after alcohol and tobacco (Connor et al., 2021). In 2018, the United Nations predicted 3.9% (around 192 million) of the adult population in the whole world has used cannabis in the last year (United Nations, 2023). The Diagnostic and Statistical Manual of Mental Health Disorders (2013) classified the inability to stop cannabis consumption, even after experiencing psychological or physical harm is known as Cannabis Usage Disorder (CUD). Although global data regarding CUD prevalence is limited, the most recent estimation in 2016 indicates 22.1 million individuals met the diagnostic criteria for this disorder (Kahana et al., 2022).

In sociological studies, cannabis abuse can be included in the category of deviant behavior, namely actions that violate the social, legal and ethical norms that apply in society (Malik et al., 2020). Previous study (Astuti, 2022) through the Journal of Health Education, it was revealed that smoking is often the initial stage before a person turns to narcotics consumption, including cannabis, and develops into more serious deviant behavior. On the other studies (Savega & Suraya, 2023) in their study found that social environmental factors in universities contributed to the rampant abuse of cannabis among students in the South Jakarta area. Through an anthropological perspective, we can see that perceptions of cannabis vary from community to community. In regions like Aceh, for example, cannabis is not always viewed negatively (Patmawati et al., 2023). Study finding (Muttaqien, 2022) shows that some Acehnese people still view cannabis as part of local culture, not merely a prohibited substance. This confirms that local cultural perceptions greatly influence people's views on cannabis.

From a sociological and social perspective, this approach can explain how weak social structures, such as loose social control, peer influence, and lack of family attachment encourage cannabis abuse. This is reflected in a study finding (Fadhlullah, 2015) in Beutong Ateuh Subdistrict, which shows that economic problems, weak supervision by the authorities, and residents' involvement in cannabis cultivation are the main causes of its circulation. In addition, macro-structural factors such as population density and regional minimum wage (UMP) disparities may indirectly influence cannabis use (Pertama et al., 2019). Densely populated urban areas with lower UMP tend to concentrate economic stressors and reduce access to healthy coping mechanisms, which could escalate the likelihood of deviant behavior, including substance abuse.

The psychological approach highlights factors internal to the individual, such as stress, emotional instability, and the desire to seek new experiences. Study findings (Pramesti et al., 2022) support this, where academic pressure and emotional distress make college students more vulnerable to the use of addictive substances, including cannabis. According to DSM-V (American Psychiatric Association, 2013), individuals who abruptly stop using cannabis after prolonged, heavy use may experience mild physical withdrawal symptoms, such as anxiety and insomnia, which can persist for several weeks and resemble symptoms seen with sedative withdrawal. However, in contrast to withdrawal from substances like cocaine, opioids, and alcohol, the withdrawal effects from cannabis tend to be less severe in terms of behavioral and psychological consequences. Compared to other substance use disorders, cannabis use disorder typically develops over a more extended period and often emerges within a context of social use, which may be more frequent than with other drugs associated with abuse.

This research uses the variables of population density, provincial minimum wage (UMP), education level, and general crime rate to indicate and analyze the level of cannabis use through the perspectives of psychology, sociology, and anthropology. Researching cannabis usage through psychological, sociological, and anthropological perspectives is important to gain a comprehensive understanding of the complex factors that drive its use, including individual motivations, social influences, and cultural perceptions. This multidisciplinary approach allows for more effective prevention strategies and policies that are sensitive to both personal and societal contexts. Population density in the context of sociology can trigger social pressure

and alienation of individuals in the community, which often leads to deviant behavior. Dense neighborhoods also reduce the effectiveness of informal social controls, making anti-narcotics norms difficult to enforce. In the context of anthropology, living in dense communities can shape certain urban cultures, including tolerance for the use of psychoactive substances as a form of solidarity. Sociology notes that the low provincial minimum wage reflects economic inequality and structural injustice, encouraging individuals to seek escape through deviant behavior. In addition, anthropology sees that economic conditions can also influence the meaning of marijuana, such as a symbol of resistance to oppressive systems in marginalized groups.

Low levels of education in a sociological context correlate with a lack of access to information and formal social norms, making individuals vulnerable to deviant behavior. Education, which plays a role in shaping social control, is also unable to function. Anthropology notes the importance of education not only as a formal tool, but also as a process of inheriting cultural values. The loss of formal education in certain societies can be replaced by local values or cultures that may be permissive of marijuana. Ultimately, high rates of general criminality in a society indicate weak social control structures and law enforcement, thus creating social conditions where illegal and deviant behavior becomes more common and less feared (Pratama et al., 2023). From an anthropological perspective, high crime reflects the transformation of values in society. When cannabis use becomes part of accepted social practices, the behavior is eventually no longer referred to as a crime, but part of cultural identity.

This research aims to address existing gaps in academic literature. Firstly, studies on deviant behavior related to cannabis abuse remain scarce, particularly those employing a qualitative approach to explore the personal experiences of individuals involved. Secondly, this study offers a contribution by comprehensively integrating three levels of analysis through literature review, secondary data, and qualitative data, which is anticipated to yield a more profound understanding of the underlying causes and consequences of cannabis abuse in Indonesia. Finally, this research utilizes the three perspectives mentioned above, namely psychological, sociological, and anthropological. These three perspectives can provide a new perspective on cannabis use in Indonesia.

To address these limitations, this study integrates systematic literature review, machine learning analysis of secondary provincial data, and qualitative interviews within a single mixed-methods framework. Rather than relying solely on conventional statistical analysis or qualitative interpretation, this approach combines predictive modelling with contextual explanations to provide a more comprehensive understanding of cannabis abuse in Indonesia. Despite the growing body of literature, two important limitations remain. First, previous studies have predominantly examined cannabis abuse from a single disciplinary perspective, limiting a comprehensive understanding of the interactions between psychological, sociological, and cultural factors. Second, relatively few studies have applied machine learning techniques to identify the relative importance of socioeconomic and demographic predictors while simultaneously integrating qualitative evidence to explain the underlying mechanisms. Consequently, empirical evidence combining predictive modelling with contextual exploration remains limited, particularly in Indonesia. Accordingly, this study aims to examine the psychological, sociological, anthropological, and socioeconomic factors associated with cannabis abuse in Indonesia by integrating systematic literature review, machine learning analysis of secondary data, and qualitative inquiry. This multidisciplinary mixed-methods approach is expected to contribute to the development of a more comprehensive understanding of cannabis abuse while providing empirical evidence to support future prevention and intervention strategies.

## Method

This study employed an explanatory mixed-methods design integrating a systematic literature review, secondary quantitative data analysis using machine learning, and qualitative interviews to obtain a comprehensive understanding of cannabis abuse in Indonesia. The mixed-methods approach was selected to combine the strengths of predictive modelling with contextual exploration, allowing quantitative findings to be interpreted through participants' lived experiences (Creswell & Poth, 2018). The systematic literature review was conducted following the PRISMA 2020 guidelines (Page et al., 2021) to identify empirical evidence regarding the psychological, sociological, and anthropological determinants of cannabis abuse. This research was conducted in three main phases. The first phase involves a systematic literature review following the PRISMA 2020 guidelines to identify key trends, theories, and gaps in existing research. PRISMA ensures transparency by documenting study selection, eligibility criteria, and data extraction processes. This process utilized the Google Scholar database with the keywords "psychology AND sociology AND anthropology AND cannabis" and followed the PRISMA 2020 method for article selection and filtering.

In the second stage, the quantitative component utilized secondary provincial-level data obtained from Statistics Indonesia (BPS). The dataset consisted of provincial socioeconomic and demographic indicators,

including Provincial Minimum Wage (UMP) and population density, which were analysed together with provincial cannabis abuse data. These variables were selected because previous studies have consistently identified socioeconomic inequality and demographic characteristics as important determinants of substance abuse (Connor et al., 2021; Indiani et al., 2022). The dataset was organized in tabular format and analysed using Orange Data Mining software. Four supervised machine learning algorithms, namely Decision Tree, Random Forest, Support Vector Machine (SVM), and Neural Network, were implemented to compare predictive performance and identify the most influential predictors of cannabis abuse. Decision Tree recursively partitions data into homogeneous groups to produce interpretable classification rules (Quinlan, 1986), whereas Random Forest improves prediction accuracy and reduces overfitting by aggregating multiple decision trees (Breiman, 2001). Support Vector Machine is effective for high-dimensional classification problems (Cortes & Vapnik, 1995), while Neural Network is capable of modelling complex nonlinear relationships among predictor variables (LeCun et al., 2015). For analytical purposes, provinces were classified into relatively higher and lower cannabis abuse categories based on the distribution of provincial prevalence in the secondary dataset. This categorization was intended to facilitate comparative machine learning classification rather than to establish absolute epidemiological thresholds. Therefore, the resulting classifications should be interpreted as relative analytical categories.

To assess the performance of our models, we employed several evaluation metrics: Area Under the Curve (AUC), which measures the classifier's performance across different thresholds; Classification Accuracy, representing the percentage of correct predictions; F1-Score, the harmonic mean of precision and recall; Precision, the ratio of true positives to all predicted positives; Recall (or sensitivity), the ratio of true positives to all actual positives; and the Matthews Correlation Coefficient (MCC), a balanced measure for binary classification tasks. Additionally, we calculated feature importance to identify the most influential predictor variables in our models.

The variables used to predict cannabis use included population density, provincial minimum wage (UMP), education level, and general crime rate. Population density is related to high mental stress due to crowded environments that increase individuals' vulnerability to deviant and addictive behaviors as an escape. Social and economic inequality can be reflected in low provincial minimum wages (UMP) and high crime rates. These inequalities create structural conditions that trigger deviant behavior. The level of education acts as a social protector, where low levels of education correlate with a lack of knowledge about substance use. Overall, these four predictor variables correlate with the norms and culture of each province, where inequalities between them create opportunities for the inheritance of cultural values. Cultural values that legalize cannabis use will increase the occurrence of the behavior, as it is not considered a crime but as part of cultural identity (Putrihasan, 2024).

The third phase involves qualitative research. Qualitative research emphasizes understanding context, meaning, and human experiences to dig deeper into the subjective understanding of cannabis use from a social and psychological perspective (Creswell & Poth, 2018). Qualitative data is obtained from three participants, namely a farmer from Sumatra, a religious figure from Aceh, and a cannabis user plus dealer from West Java. The qualitative component involved three purposively selected participants representing different perspectives on cannabis use, including a former cannabis farmer, a university student with previous cannabis use experience, and a religious leader. The participants were selected to provide diverse sociocultural contexts rather than statistical representation. Consequently, the qualitative findings are presented as contextual explanations that complement the quantitative results rather than as evidence for population-level generalization. All participants voluntarily agreed to participate and provided informed consent before the interviews. Participant anonymity and confidentiality were maintained throughout the research process.

## Participant

To ensure a comprehensive understanding of cannabis use within the Indonesian context, qualitative research will be conducted with participants who meet specific criteria. Participants must be individuals who have experience with or are currently using cannabis, allowing for firsthand accounts of motivations, patterns, and perceived effects. The study will aim for a diverse sample, including both men and women, to explore potential gender-specific nuances in cannabis use. Finally, all participants will be Indonesian citizens, ensuring that the findings are relevant to the specific socio-cultural environment of Indonesia. The samples of participants were chosen based on their province origin. Sumatra, Aceh, and West Java were chosen due to the highest number of usage found in BPS data.

## Data Analysis

Quantitative data was analyzed using the Orange 3.1 machine learning. The data analysis in this study was conducted using a classification approach to identify the most influential factors on cannabis use in Indonesia. The classification models used were decision tree and neural network, each of which was evaluated based on metrics such as AUC (Area Under Curve), accuracy (CA), F1-score, precision, recall, and MCC (Matthews Correlation Coefficient). The use of these models is intended to compare classification performance and identify variables that contribute significantly to prediction. Additionally, the ROC (Receiver Operating Characteristic) curve and Feature Importance model are also used in order to evaluate the decrease in AUC due to the removal of each input variable. It is then combined with the results from the literature review and qualitative data to find the overall result of this research.

Qualitative data were analysed using thematic analysis following transcript familiarization, coding, categorization, and theme development. The qualitative findings were subsequently integrated with the quantitative results to explain how psychological, sociological, and anthropological factors influence cannabis abuse in Indonesia.

## Result

### Literature Review Using Prisma Model

A systematic review of the literature was performed by searching for relevant prior publications in Google Scholar, ScienceDirect, and Scopus. This search yielded 5,710 articles based on the specified keywords above. Subsequently, an initial screening was conducted based on publication year, with the inclusion criteria being articles published within the preceding 5 years, utilizing approaches from all fields of psychology, sociology, and anthropology, and sourced from accredited journals, excluding final projects or theses. This is the PRISMA Model result of the review, based on Haddaway et al. (2022):

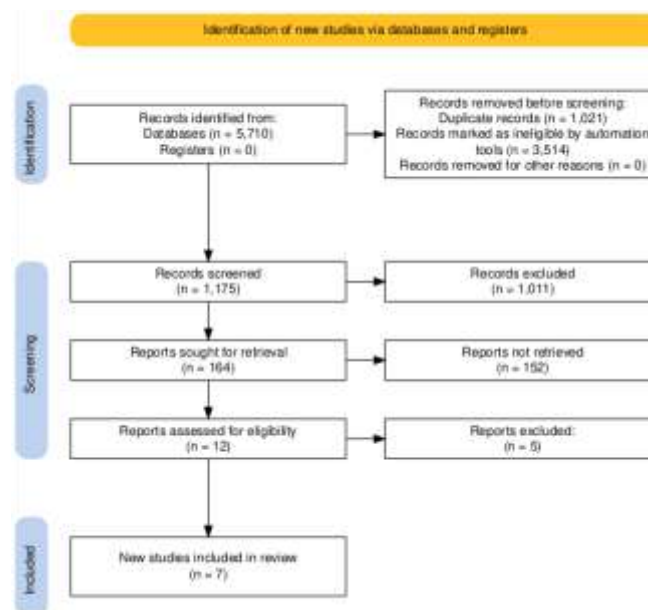


Figure 1. PRISMA Model

### Literature Review

There are 7 articles that fit all the inclusion criteria after screening, as is shown below:

Table 1. Literature Review

| Researchers           | Methods                                                                                                                                                                                                                                                                      | Results                                                                                                                                                                                                                                         |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Costoya et al. (2023) | This research explored the evolution of marijuana-related studies in Health Sciences journals from 2001 to 2020, resulting in a total of 36,982 files. The method involved extracting data from the Web of Science Core Collection and PubMed, focusing on MeSH terms within | The analysis of these terms revealed a shift over time from a focus on negative aspects and "marijuana abuse" towards more neutral language like "marijuana use" and an increased emphasis on therapeutic applications and "medical marijuana." |

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                          | specific branches like Chemicals and Drugs, Psychiatry and Psychology, and Anthropology, Education, Sociology, and Social Phenomena.                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Ugwu (2022)              | This study used in-depth interviews (IDI) between November 2018 and June 2019 with 18 participants selected through snowball sampling to understand cannabis usage and motives in Awka, Southeast Nigeria.                                                                                                                                                                                                                                                                                                              | The analysis of the interview data revealed two major themes, which are coping and enhancement. The result stated that participants mainly use cannabis for non-medical purposes to help users cope with life challenges. Cannabis usage also enhances the users' strength.                                                                                                                                                                                                                                                                                                                                                                           |
| Borodovsky et al. (2020) | This study portrays an applied review and commentary using findings from psychological science to help regulators understand the behaviors associated with THC-rich cannabis use, regardless of whether it's for medical or recreational purposes. It is structured into three main sections, each focusing on a key player in cannabis regulation, namely the consumer, industry, and regulatory agency itself.                                                                                                        | This paper explored how psychological principles can help regulators shape policies by altering factors influencing cannabis use patterns. Ultimately, it aims to guide regulatory actions and decision-making to mitigate potential harms from cannabis misuse.                                                                                                                                                                                                                                                                                                                                                                                      |
| Siddiqui et al. (2022)   | A comprehensive search was done through PubMed, Scopus, Web of Science, and Google Scholar for English, peer-reviewed articles published between 2013-2022. Using keywords like "cannabis" AND ("consumer behavior" OR "consumer cultural factor" OR "consumer social factor" OR "consumer psychological factor"), 65 relevant articles were identified. These articles focused on cultural, social, and psychological factors influencing legal cannabis use, including country-specific analyses of legal quantities. | This review highlights that cultural factors, including political views and religious beliefs, significantly influence the acceptance or rejection of cannabis use, with formal regulation through medical systems offering safer access and harm reduction. Socioeconomic status also plays a crucial role; while cannabis use spans all classes, excessive use is more common among lower socioeconomic groups, less-educated individuals, and those experiencing racism. It was also identified that addressing public misconceptions through education, proper labeling, and scientific evidence can foster greater acceptance of legal cannabis. |
| Feingold et al. (2021)   | This is a literature review that explores the psychological dimensions of cannabis use and Cannabis Use Disorder (CUD) through diverse methodologies and psychological perspectives. It consolidates existing evidence, presents new findings, and pinpoints future research, practical, and policy directions in the field.                                                                                                                                                                                            | Cannabis has both therapeutic and adverse effects, with research evaluating its impact on behavior and cognition, including driving safety and learning. Studies also explored links between childhood trauma and adolescent cannabis use, its role in treating PTSD, dose titration pharmacology, and the residual effects of chronic use on brain structure and cognitive function.                                                                                                                                                                                                                                                                 |
| Baciu (2024)             | A cross-sectional study in Bucharest surveyed 731 individuals (aged 14-57) using an omnibus questionnaire about drug consumption. The data was then statistically analyzed using SPSS version 21, adhering to ethical research standards.                                                                                                                                                                                                                                                                               | In the study, 11.5% of participants reported lifetime illicit drug use, with cannabis being the most common, while 2.8% had used drugs in the past month. Curiosity was the primary reason for trying drugs, while fear of addiction and illness deterred non-users.                                                                                                                                                                                                                                                                                                                                                                                  |
| Castro & Fraga (2023)    | This is a qualitative study using direct observation and semi-structured                                                                                                                                                                                                                                                                                                                                                                                                                                                | Societies constantly navigate transgressions of rules, which can also                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |

interviews to 8 men and 1 women between the ages of 20-50 years old. These people belong to the middle class and are living in neighborhoods with good urban and transport structures in Greenville.

spark moral shifts and demands for legal changes. In Brazil, the practice of home cannabis cultivation, or "the green one," acts as a catalyst for new moralities among growers. These individuals form support networks, sharing knowledge, resources, and fostering a sense of liberation from existing formal and informal repressions, ultimately advocating for changes in institutionalized laws to normalize their practice.

### Secondary Data Analysis Result

The quantitative analysis was performed using four supervised machine learning algorithms, namely Decision Tree, Random Forest, Support Vector Machine (SVM), and Neural Network. Model performance was evaluated using Area Under the Receiver Operating Characteristic Curve (AUC), Classification Accuracy (CA), Precision, Recall, F1-score, and Matthews Correlation Coefficient (MCC). These complementary evaluation metrics were used to assess the predictive performance and classification reliability of each model. This research focuses on developing a predictive model for provincial cannabis user rates in Indonesia, classifying them into "low rate" and "high rate" categories. These classifications are determined by analyzing the average cannabis use data provided by BPS (Statistics Indonesia). The model incorporates several key predictors: the provincial minimum wage (UMP), general crime rates within each province, population density, and the number of high school graduates per province. All the secondary data for these variables is sourced from BPS 2023, ensuring a robust dataset for analysis.

Table 2. Matrix Evaluation

| Model                 | AUC   | CA    | F1    | Prec  | Recall | MCC   |
|-----------------------|-------|-------|-------|-------|--------|-------|
| <b>Tree</b>           | 0.995 | 0.964 | 0.857 | 1.000 | 0.750  | 0.849 |
| <b>Neural Network</b> | 0.948 | 0.893 | 0.400 | 1.000 | 0.250  | 0.471 |

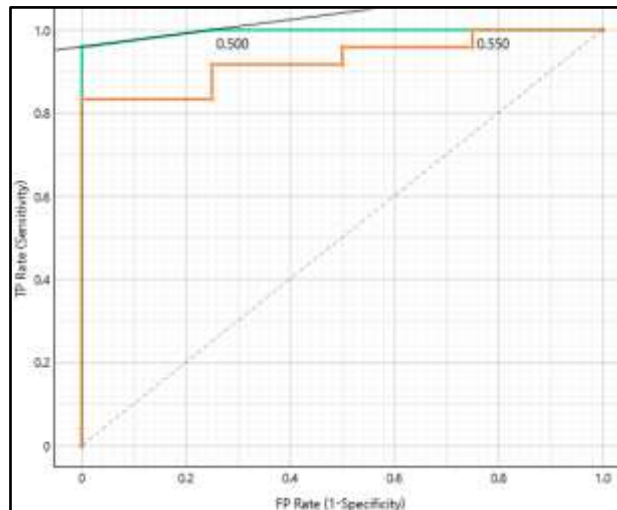
AUC (Area Under Curve) shows the highest value owned by the Tree model (0.995), while the lowest value is owned by the Neural Network (0.948). This means that the Tree model has a very high classification ability in distinguishing the possibility of deviant behavior or not. CA (Classification Accuracy) measures how many model predictions are correct compared to the total amount of data tested. The evaluation matrix table shows that Tree (0.964) is higher than Neural Network (0.893). This means that the Tree model makes more correct predictions than Neural Network on the same data. F1 is the balance between Precision and Recall. F1 is useful when the data is not balanced.

The table shows the Tree model 0.857, indicating that the model is able to provide balanced prediction results and is not only accurate in recognizing deviant cases, but also rarely mistaken in marking non-deviant cases as deviant. Meanwhile, the Neural Network model scores 0.400, indicating that the model is not good enough at maintaining a balance between accuracy and prediction coverage. Recall is the ability of the model to find cases that are truly deviant. Tree shows 0.750, which means that out of 100 people who are truly deviant, the Tree model successfully detects 75 people. While the Neural Network is only 0.250 or only 25 out of 100 deviants were successfully found. MCC is a metric that measures the overall quality of predictions and sees the model's performance fairly when the data is not balanced. The Tree model scores 0.849, indicating that its predictions are consistent for deviants and non-deviants. Meanwhile, the Neural Network model scores 0.471, which tends to be weak.

These results clearly indicate that the Tree model is significantly more effective at classifying deviant behavior compared to the Neural Network model for this specific dataset. The Tree model's AUC of 0.995 (very close to the perfect score of 1.0) means it's exceptionally good at distinguishing between individuals who exhibit deviant behavior and those who don't. Overall, the MCC score of 0.849 for the Tree model confirms its strong, consistent performance across all types of predictions, even with imbalanced data. This means that the Tree model should be preferred for predicting deviant behavior in this context, as it is more accurate, better at identifying true cases, and provides a more balanced and reliable set of predictions.

Among the evaluated algorithms, the Decision Tree model achieved the highest predictive performance based on AUC and other classification metrics. Although the obtained AUC value was very high, the model performance should be interpreted cautiously because the analysis was conducted using aggregated provincial secondary data with a relatively limited number of observations. Therefore, the findings indicate strong predictive capability within the analysed dataset rather than definitive evidence of model generalizability.

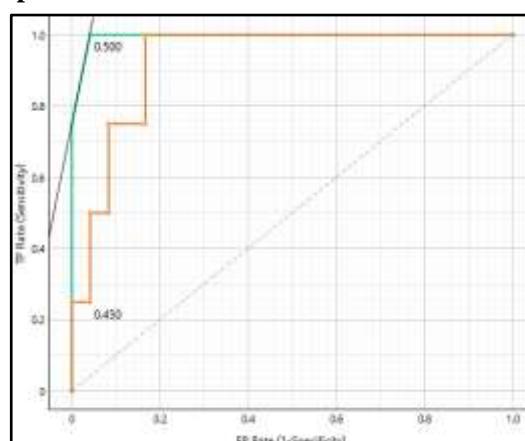
**Graph 1. ROC Row for High Score Prediction**



The ROC (Receiver Operating Characteristic) curve displayed above evaluates the classification model's ability to distinguish between positive and negative instances. Its strong initial discriminatory power, indicated by the steep rise, suggests effectiveness at lower false positive rates. The orange curve, positioned significantly above the diagonal line representing a random classifier, indicates that the model performs better than chance. The steep initial rise of the orange curve suggests that at lower false positive rates, the model achieves a substantial true positive rate, demonstrating good discriminatory power early on. The subsequent plateaus and changes in slope reflect the trade-offs between sensitivity (True Positive Rate) and specificity (1 - False Positive Rate) at different classification thresholds. For instance, at a False Positive Rate of approximately 0.8 (as seen at the point labeled "0.550" on the orange curve), the model achieves a True Positive Rate of 1.0, meaning it correctly identifies all positive cases at the cost of incorrectly classifying a large fraction of negative cases as positive. The green curve suggests a potentially superior model, maintaining a higher True Positive Rate across a wider range of False Positive Rates compared to the orange curve.

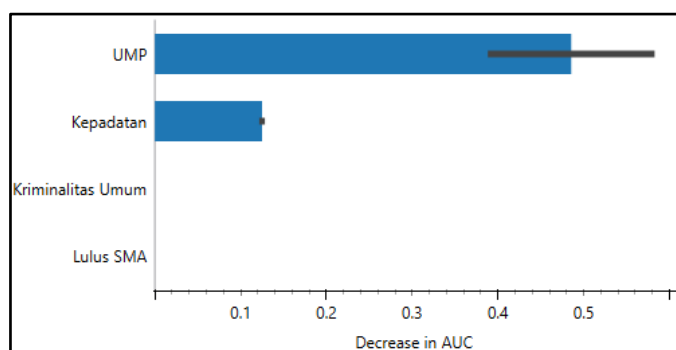
While the model shows a strong ability to identify true positives, achieving a 1.0 True Positive Rate at a False Positive Rate of approximately 0.8, the ideal operating point hinges on balancing the costs of false positives and false negatives within the specific application. The green curve, by comparison, hints at a potentially more robust model with consistently higher true positive rates across various false positive rates. Overall, the orange ROC curve indicates a model with a strong ability to identify true positives, but the optimal operating point would depend on the specific costs associated with false positives and false negatives in the given application.

**Graph 2. ROC Row for Low Score Prediction**



In this ROC Curve, especially the orange curve, while showing some discriminatory ability above the diagonal line representing a random classifier, indicates a less robust performance compared to a curve closer to the top-left corner. The initial steep rise suggests that at very low false positive rates, the model can identify a moderate proportion of true positives. However, the subsequent horizontal and near-horizontal segments indicate that increasing the false positive rate yields diminishing returns in terms of the true positive rate. For instance, at a False Positive Rate near 0.1, the True Positive Rate reaches approximately 0.75 and then plateaus significantly. The points labeled "0.500" and "0.450" likely represent performance metrics at specific thresholds, though their exact meaning is unclear without additional context on the model's output. The green curve appears to represent a superior model, consistently maintaining a higher True Positive Rate across various False Positive Rates. In summary, the orange ROC curve demonstrates a model with some capacity to correctly classify positive instances, but its overall performance and the trade-off between sensitivity and specificity might not be optimal, especially when compared to the performance suggested by the green curve.

**Chart 1. Feature Importance**



Feature Importance is a machine learning model used to show how much each variable contributes to the model's ability to predict deviant behavior. In this study, feature importance is measured based on the decrease in AUC value when a feature is removed. Feature importance analysis indicated that Provincial Minimum Wage (UMP), population density, and socioeconomic characteristics contributed substantially to the prediction of cannabis abuse. These variables should be interpreted as statistically important predictors within the classification model rather than direct causal determinants of cannabis abuse. The relationship between Provincial Minimum Wage and cannabis abuse appears to be indirect and context dependent. Higher regional income may increase purchasing power and accessibility, whereas regions with higher socioeconomic development may simultaneously provide stronger educational opportunities, social control, and health services. Consequently, the association identified by the machine learning models should not be interpreted as a simple linear or causal relationship.

### Qualitative Result

To complement the quantitative findings, semi-structured interviews were conducted with three purposively selected participants representing different sociocultural backgrounds. The qualitative findings are presented to explain the contextual mechanisms underlying the quantitative results rather than to provide statistical generalization. This study involved three informants who had different backgrounds and experiences related to the phenomenon of marijuana use in Indonesia, namely a religious figure in Aceh (Fadil), a former marijuana farmer from the mountains of Sumatra (Rohman), and a student from West Java who was a former marijuana user and dealer (Kiran).

Fadil, a religious figure from Aceh, explained that in the Islamic perspective, marijuana is included in the category of substances that intoxicate and damage the mind, so its use is haram. He emphasized, *"Because something that intoxicates or damages the mind is prohibited in Islam. Therefore, marijuana is prohibited because its effects damage the mind. Therefore, marijuana is haram"* (Fadil, June 8, 2025). According to him, religious education must be strengthened, especially in areas that still consider marijuana as an ordinary plant. He believes that a contextual and persuasive approach to preaching can help people understand the dangers of marijuana, both religiously and socially.

Meanwhile, Rohman, a 38-year-old former marijuana farmer from the mountains of Sumatra, admitted to growing marijuana due to economic constraints and access to legal agricultural facilities. He said, *"Initially because of the economy. We live in the interior, access to fertilizer is difficult, the roads are not good. But marijuana is easy to grow, doesn't require a lot of money. It's also quick to harvest. Yes, that's why many of*

us grow marijuana” (Rohman, June 10, 2025). After being arrested and serving his sentence, Rohman abandoned the practice and switched to legal farming. *“After getting out of prison, I realized. Even though the marijuana yield is large, the risks are also high. Now I grow coffee, corn, slowly, but calmly”* (Rohman, June 10, 2025).

Kiran, a 24-year-old student from West Java, said that he started using marijuana because of academic pressure and mental health. *“Initially it was just to relieve stress. Assignments piled up, sleep was hard, sometimes anxiety too. Then a friend offered me marijuana. He said it could make you calm”* (Kiran, June 17, 2025). Not only as a user, Kiran was also once a dealer among students. He admitted that he was driven by economic needs and family pressure. *“At home I was also pressured, told to graduate quickly. So sometimes I thought, okay, as long as it's finished quickly”* (Kiran, June 17, 2025). After being caught and receiving emotional pressure from his family, he decided to stop completely. *“When I was caught, it was a turning point. My family was very disappointed. Since then I have stopped completely. Now I even help with counseling about drugs”* (Kiran, June 17, 2025).

These findings show that marijuana abuse in Indonesia is not only caused by individual factors, but is also influenced by local social, economic, and cultural conditions. Religious figures emphasize the importance of a moral and spiritual approach, farmers speak from the perspective of economic coercion, and students highlight mental and academic pressures. All three provide a picture that marijuana abuse is a complex problem that requires a cross-sectoral approach: from education, economic empowerment, to mental health support

## Discussion

The findings of this study illustrate the complexity of cannabis abuse in Indonesia when examined through a multi-method, multiperspective lens involving psychological, sociological, and anthropological frameworks. The integration of a systematic literature review, machine learning analysis, and qualitative interviews reveals that cannabis use cannot be fully understood without considering individual psychological conditions, community-level influences, and broader socio-cultural structures. These layers interact dynamically, making cannabis use both a personal behavior and a socially situated phenomenon.

The integration of quantitative and qualitative findings demonstrates substantial convergence across both components of the study. The machine learning analysis identified socioeconomic indicators as important predictors of cannabis abuse, whereas the interview findings explained how economic pressure, peer influence, cultural acceptance, and psychological coping contributed to cannabis use. Participants consistently described cannabis use as being influenced by multiple interacting factors rather than a single determinant, supporting the multidimensional framework adopted in this study.

The literature review underscores evolving global perspectives on cannabis. It documents a shift from solely negative framings of cannabis as a dangerous substance toward more nuanced views that include its therapeutic potential and socio-cultural relevance. Notably, cannabis use is often motivated not by medical necessity but by psychological coping and social enhancement (Urits et al., 2020). Factors such as curiosity, emotional pressure, peer influence, and cultural permissiveness frequently emerge in the literature as significant drivers of usage, particularly among individuals in lower socioeconomic groups or marginalized communities. This indicates that cannabis use is often embedded in larger struggles for identity, survival, and relief.

The machine learning analysis using Orange software reinforces these insights by quantifying the role of structural predictors. Feature importance results show that Provincial Minimum Wage (UMP) and population density are the most significant contributors to cannabis use. UMP, as an economic indicator, reflects broader patterns of income disparity and financial hardship. Low wages may push individuals toward cannabis cultivation or consumption as a coping mechanism or source of income. At the same time, high UMP may paradoxically facilitate access to such substances due to increased purchasing power. This indicates that areas with low UMP tend to have low levels of welfare, increasing the potential for economic stress, social frustration, and the desire to seek escape through substance abuse (Indiani et al., 2022; Siahaan, 2015). This economic disparity is a potential impetus for individuals to engage in deviant behavior, both as drug users and dealers, in order to make ends meet. Interpretatively, high UMP in a region can be associated with higher purchasing power, thus opening up access to illegal products including cannabis. In this context, UMP does not directly cause cannabis use, but can be an indicator of the economic conditions that allow such access.

Population density, another dominant variable, is sociologically associated with reduced social control, heightened stress, and increased exposure to deviant subcultures, especially in urban slums or high-crime neighborhoods. All of the above are risk factors for consumptive behavior towards addictive substances such as cannabis. These findings align with social disorganization and strain theories, suggesting that environmental pressure and systemic inequality are key catalysts for deviant behavior. The combination of

environmental pressures and financial means creates greater potential for cannabis use, especially in dense, middle-income urban areas.

In terms of demographics, population density also plays an important role in encouraging deviant behavior. High-density areas tend to experience various social pressures, ranging from limited public space, increased unemployment, to weak social control. Previous study (Pahlevi (2020) in Samarinda City shows that densely populated urban villages are hotspots for drug abuse due to weak supervision and high levels of promiscuity. Other study (Lia, 2022) also described how social dynamics in dense communities can facilitate the spread of deviant cultures such as marijuana consumption.

This link between economic and demographic pressures is also in line with the theory of strain and social disorganization, where inequality and social breakdown in dense and poor communities create ideal conditions for the emergence of deviant behavior. Study findings (Pramesti et al., 2022) who underlined that in addition to individual factors, the environmental context has a major influence on substance abuse. Nationally, a study (Supratman & Runturambi, 2022) shows that the drug problem in Indonesia is not only a health issue, but also a structural issue involving economic distribution inequality and urbanization density. Therefore, prevention efforts must involve a cross-sectoral approach that includes improving the economic conditions of the community and managing a more humane urban layout.

In addition, the relevance of cannabis legalization in a medical and legal context also continues to be an actual discourse. Studies (Putranto & Mangesti (2024; Pangaribuan (2024) highlight that cannabis policies must consider the socio-economic context and population density, so that the implementation of the law does not have a discriminatory impact on vulnerable communities. Law enforcement that does not consider structural factors can actually exacerbate the marginalization of poor groups in densely populated areas. Therefore, the integration of economic and demographic approaches in the analysis of deviant behavior is key to comprehensively understanding and addressing cannabis abuse.

Qualitative data deepen these patterns by revealing the lived realities behind statistical correlations. The interview with a religious leader in Aceh highlights how cannabis is framed as haram within Islamic teachings, signaling strong moral opposition rooted in religious values. This perspective illustrates how dominant cultural norms can suppress cannabis use by moral framing. In contrast, the testimony of a former cannabis farmer in Sumatra reflects a different logic. His use of cannabis farming was driven by economic necessity, lack of infrastructure, and the practical benefits of cultivating a plant that grows easily and yields profit. Here, anthropology offers insight into how cultural and economic contexts redefine deviance—what is criminal in legal discourse may be considered pragmatic in subsistence cultures. The student from West Java, who used cannabis to cope with academic stress and eventually became a dealer, illustrates the psychological and social dimensions of usage. His trajectory shows how peer influence, pressure to perform, and emotional vulnerability coalesce into substance use, which becomes normalized within certain youth subcultures.

Across all data sources, a multi-level explanation emerges. On the micro level, psychological factors such as stress, anxiety, and emotional instability lead individuals to use cannabis as a form of self-medication. At the meso level, communities with weak social control, low education, and ambiguous cultural norms regarding cannabis create environments where usage can flourish. At the macro level, economic inequality and urban overpopulation contribute to systemic conditions that foster both supply and demand. Anthropologically, cannabis use may also take on symbolic meaning, such as resistance to state authority or affirmation of group identity. In some regions, cannabis is seen not merely as a drug but as a cultural artifact, with historical and ritualistic connotations.

This comprehensive analysis, however, is not without limitations. The use of BPS data for machine learning analysis restricts interpretation due to potential underreporting and lack of specificity in cannabis-related metrics. While it doesn't only provide cannabis usage provincially, also provides quantitative insights on Provincial Minimum Wage (UMP) and population density as triggering factors, may be limited in its granularity to measure the specific prevalence of cannabis use at the provincial level. In addition, BPS data tends to reflect reported cases, which could differ from the true prevalence and could have uncontrolled bias. The small number of qualitative interviews reduce the depth and validity of personal narratives. Additionally, while the literature review was systematic, the inclusion of only seven articles may not capture the full breadth of existing research, particularly from non-English or grey literature sources.

Research on cannabis use from psychological, sociological, and anthropological perspectives makes a significant theoretical contribution to the understanding of how cannabis use behavior is influenced by individual, social, and cultural factors. Culturally, the findings expand the understanding of how the construction of meaning towards cannabis differs across societal groups, including how local values, social symbolism, and cultural narratives shape individuals' perceptions of cannabis use-whether as a form of

recreation, emotional escape, or even as a spiritual practice. Meanwhile, from the social side, this research highlights the importance of the role of peer groups, social norms, and social identity processes in shaping one's decision to use cannabis. This enriches theories of deviant sociology, collective behavior, and symbolic interactionism in the context of substance use.

Practically, the findings of this study can be used as a basis for designing intervention programs that are more contextual and sensitive to local cultural values. Public policies, such as user prevention or rehabilitation campaigns, need to consider not only medical or legal factors but also psychosocial motives and the cultural background of users. For example, community-based educational approaches will be more effective if delivered through figures who have social credibility in the target cultural environment. In addition, an understanding of the symbolic meaning of marijuana among adolescents or certain subcultural groups can help policy makers in drafting regulations that are not only repressive but also educative and participatory, thus minimizing social resistance and increasing the effectiveness of policy implementation.

Overall, the findings indicate that cannabis abuse in Indonesia is associated with the interaction of demographic, socioeconomic, psychological, sociological, and cultural factors. The quantitative analysis identified statistically important predictors, whereas the qualitative findings provided contextual explanations that strengthen the interpretation of the machine learning results.

For future research, longitudinal and ethnographic studies are needed to better understand how cannabis use evolves over time and in varying socio-cultural contexts. There is also a need to expand qualitative sampling to include female users, health professionals, and law enforcement to capture a broader range of perspectives. Comparative studies between provinces with differing socio-economic and cultural profiles would further elucidate how structural and symbolic factors intersect to shape behavior.

## Conclusion

This research aimed to analyze the factors influencing cannabis abuse in Indonesia using a multi-method approach: systematic literature review, machine learning analysis of secondary data, and qualitative insights. The results reveal that economic and demographic factors, specifically low Provincial Minimum Wage (UMP) and high population density are key contributors to cannabis use. Low wages may lead to economic stress and increase vulnerability to drug use as a coping mechanism, while densely populated areas heighten social tension and reduce social control, fostering risky behaviors. The literature review supports these findings by showing how social, psychological, and cultural factors interact in shaping substance use.

In conclusion, cannabis abuse in Indonesia is best understood as a multi-layered phenomenon shaped by psychological stress, sociological inequality, and anthropological meaning systems. Structural conditions such as low income and high population density amplify vulnerabilities, while cultural norms and individual coping strategies direct behavior. Policies aimed at reducing cannabis abuse must therefore address not only the symptoms but also the social and economic roots, using culturally sensitive and community-based approaches to prevention and rehabilitation. Urban development should also address social stress and improve community cohesion to prevent environments conducive to substance abuse.

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