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Analysis of Pollution Contributor in ASEAN Region using Geo Mapping Tools

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ABSTRACT: Digital Investigation on the cloud platform is a challenging task. Preservation of evidences is the ultimate goal behind performing cloud forensics. In the Virtual Scenario, Virtual Machines contain evidences. If once VMDK (Virtual Machine Disk file) is destroyed, it is impossible to recover your VM. At present there does not exist a single mechanism that can recover a destroyed (deleted) VM again which is the flaw in VM itself. All the activities on the VM is logged in VM, whereas activities of CSP (Cloud Service Provider) is logged on the server. So even if someone deleted the VM, all the evidences will be lost. This creates a disaster for the user and acts as a barrier for a forensic investigator to dig out the private crucial data of user that was stored in the Virtual Machine sometime. We proposed with this research work, we explore the existing mechanisms and challenges in the current cloud scenario and propose an idea to prevent the unauthorized deletion of the Virtual Machines snapshots.

I.INTRODUCTION

Air pollution is a critical environmental challenge with far-reaching consequences for human health, ecosystems, and the global climate [1]. The ASEAN (Association of Southeast Asian Nations) region, a dynamic hub of economic growth and urbanization, faces a mounting struggle to maintain air quality amidst rapid development [2]. This study delves into the major contributors to air pollution within the ASEAN region, employing geomapping tools to provide a crucial spatial dimension to our understanding of pollution sources and distribution. By integrating diverse datasets and applying geospatial analysis techniques, this research aims to pinpoint pollution hotspots, assess the relative contributions of various sources, and ultimately inform the development of targeted mitigation strategies.

The sources of air pollution in the ASEAN region are multifaceted and intertwined, encompassing a range of anthropogenic and natural factors [3]. Transportation, fueled by rapid urbanization and increasing vehicle ownership, plays a significant role, particularly in densely populated urban centers [4]. Industrial emissions, stemming from manufacturing, power generation, and resource extraction, release a cocktail of pollutants, including particulate matter, sulfur dioxide, and nitrogen oxides [5]. Biomass burning, associated with agricultural practices, deforestation, and peatland fires, further exacerbates air pollution, emitting substantial amounts of smoke and particulate matter into the atmosphere [6]. Additionally, the transboundary nature of air pollution necessitates regional cooperation to effectively address this shared challenge [7]. Geomapping, the synergistic integration of geographic information systems (GIS) with air pollution data, offers a powerful lens through which to analyze the spatial dynamics of air quality [8]. By mapping the concentration and distribution of pollutants, we can identify pollution hotspots, assess the relative contributions of different sources, and evaluate the efficacy of mitigation measures [9]. This study leverages a suite of geomapping techniques, including the following: interpolation**:** Estimating pollution levels at unsampled locations based on data from monitoring stations, enabling the creation of continuous pollution maps [10]. Spatial Clustering**:** Identifying areas with high concentrations of pollution, highlighting potential pollution hotspots and guiding targeted investigations [11]. Overlay Analysis: Combining different layers of spatial data, such as pollution levels, land use, and population density, to identify areas at risk and assess potential impacts [12]. Spatial Regression: Analyzing the relationship between pollution levels and other spatial variables, such as proximity to emission sources or socioeconomic factors, to understand the drivers of pollution patterns [13]. To create a comprehensive picture of air pollution in the ASEAN region, this study draws upon a diverse array of data sources. Air quality data from monitoring stations across the region provide measurements of key pollutants, including PM2.5, ozone, sulfur dioxide, and nitrogen dioxide [14]. Emission inventories offer valuable information on the sources and magnitudes of pollution from various sectors, including transportation, industry, and biomass burning [15]. Meteorological data, encompassing wind

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patterns, temperature, and precipitation, are incorporated to understand the dispersion and transport of pollutants [16]. Additionally, satellite imagery provides a synoptic view of air pollution over large areas, aiding in the identification of pollution sources and regional trends [17]. This study is poised to make significant contributions to our understanding of air pollution in the ASEAN region. By identifying pollution hotspots and vulnerable areas, we can prioritize interventions and allocate resources effectively. Assessing the relative contributions of different sources will enable the development of targeted mitigation strategies, focusing on the most significant contributors to air pollution. Analyzing spatial and temporal trends will provide valuable insights into the effectiveness of existing policies and guide future air quality management efforts. Ultimately, this research aims to enhance public awareness and understanding of air pollution issues, fostering informed decision-making and community engagement in the pursuit of cleaner air for the ASEAN region.

II. RELATED LITERATURE

Air pollution is a growing concern in the ASEAN region, driven by rapid urbanization, industrialization, and economic growth [18]. Major sources of air pollution include transportation, industrial emissions, biomass burning, and transboundary pollution [19]. These sources release a variety of pollutants, including particulate matter (PM2.5 and PM10), ozone (O3), nitrogen dioxide (NO2), sulfur dioxide (SO2), and carbon monoxide (CO) [20]. The impacts of air pollution on human health are significant, contributing to respiratory diseases, cardiovascular diseases, and premature mortality [21].Air pollution also has adverse effects on ecosystems, reducing visibility, damaging crops, and contributing to climate change [22]. Studies have shown that air pollution levels in many ASEAN cities exceed the World Health Organization (WHO) air quality guidelines [23]. This poses a serious public health challenge, particularly for vulnerable populations such as children, the elderly, and those with pre-existing respiratory conditions [24]. For instance, a study conducted in Bangkok, Thailand, found that long-term exposure to PM2.5 was associated with an increased risk of cardiovascular and respiratory mortality [25]. Furthermore, air pollution has significant economic implications for the ASEAN region. A study by the World Bank estimated that air pollution cost the region approximately US$1.3 trillion in 2016, primarily due to health impacts and lost productivity [26]. This highlights the urgent need for effective air pollution control measures in the region. Geomapping, the integration of geographic information systems (GIS) with air pollution data, has emerged as a powerful tool for analyzing the spatial dynamics of air quality [27]. By mapping the distribution and concentration of pollutants, geomapping can identify pollution hotspots, assess the relative contributions of different sources, and evaluate the effectiveness of mitigation measures [28]. Several studies have utilized geomapping techniques to analyze air pollution in the ASEAN region. For example, a study in Hanoi, Vietnam, used geospatial analysis to identify traffic-related air pollution hotspots and assess the impact of traffic management strategies [29]. Another study in Singapore used geostatistical methods to map the spatial distribution of PM2.5 and identify areas with high exposure levels [30]. Geomapping has also been used to assess the impact of transboundary air pollution in the ASEAN region. A study by Lasko et al. [31] used satellite data and atmospheric modeling to track the movement of air pollutants across national borders and identify the major contributing sources. These studies demonstrate the utility of geomapping for understanding the complex interplay of factors contributing to air pollution in the ASEAN region. Geomapping can help policymakers and stakeholders to develop targeted interventions and prioritize areas for pollution control. A variety of geospatial techniques can be employed for air pollution analysis, including Interpolation: This technique estimates pollution levels at unsampled locations based on data from monitoring stations. Common interpolation methods include IDW, kriging, and spline interpolation [32]. Spatial Clustering: This technique identifies areas with high concentrations of pollution, highlighting pollution hotspots and potential sources. Overlay Analysis: This technique combines different layers of spatial data, such as pollution levels, land use, and population density, to identify areas at risk and assess potential impacts. Spatial Regression: This technique analyzes the relationship between pollution levels and other spatial variables, such as proximity to emission sources or socioeconomic factors, to understand the drivers of pollution patterns. Spatial Autocorrelation: This technique measures the degree to which pollution levels in one location are correlated with pollution levels in nearby locations. This can help to identify spatial patterns and clusters of high or low pollution. In addition to these techniques, advancements in remote sensing and satellite imagery have provided valuable data for air pollution monitoring and analysis. Satellite-basded sensors can measure a wide range of air pollutants, including PM2.5, NO2, and SO2, providing a synoptic view of air quality over large areas. Geomapping holds great promise for advancing air pollution research and management in the ASEAN region.

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III. METHODOLOGY

This study utilizes Power BI, a powerful business analytics service, to conduct geospatial analysis of air pollution in the ASEAN region. Power BI offers a suite of tools and functionalities that enable the visualization and exploration of geographically referenced data, making it a valuable tool for understanding the spatial dynamics of air pollution. Power BI is a cloud-based business intelligence platform that allows users to connect to a wide array of data sources, transform and analyze data, and create interactive visualizations and reports. Its user-friendly interface and rich feature set make it accessible to both technical and non-technical users. For geomapping applications, Power BI offers several key functionalities. It provides a variety of map visualizations, including bubble maps, filled maps, and ArcGIS maps, allowing for the effective representation of data on geographical maps. Furthermore, Power BI can automatically geocode location data, converting addresses and place names into geographic coordinates, which enables the precise plotting of data points on maps. Beyond visualization, Power BI offers spatial analysis tools, such as clustering and filtering, to identify spatial patterns and trends in geographically referenced data. Importantly, Power BI can connect to various data sources, including Excel spreadsheets, databases, and online services, allowing for the seamless integration of air pollution data from diverse sources. Finally, Power BI enables the creation of interactive dashboards that allow users to dynamically explore data, filter information, and drill down into specific details.

The methodology employed in this study involves a systematic approach using Power BI. Initially, data acquisition and preparation are conducted, where air pollution data, specifically NOx, SO2, NH3, and CO values, are gathered for each ASEAN country from reputable sources, including monitoring stations, government agencies, and research institutions. The data is meticulously cleaned and preprocessed to ensure data quality and consistency, and formatted for compatibility with Power BI, ensuring proper data types and structures. Subsequently, Power BI's geocoding capabilities are utilized to convert location data, such as city names or coordinates, into geographic coordinates for precise mapping. The air pollution data is imported into Power BI, and relationships between the data tables are established to enable comprehensive analysis. Appropriate map visualizations, such as bubble maps or filled maps, are then selected to display the air pollution data on geographical maps, providing a clear visual representation of pollution patterns for each pollutant across the ASEAN region. Spatial analysis and visualization are central to this study.

Power BI's spatial analysis tools, such as clustering and filtering, are applied to identify pollution hotspots and areas with high concentrations of NOx, SO2, NH3, and CO. Color-coding and other visual elements are strategically used to represent the intensity of pollution levels, creating intuitive and informative maps. Interactive dashboards are developed to allow users to dynamically explore the data, filter information by location, time period, or pollutant type, and drill down into specific details, facilitating in-depth analysis and understanding. To gain a more comprehensive understanding of the factors influencing air pollution, this study integrates air pollution data with other relevant datasets, such as population density, land use, industrial activity, and meteorological data. Power BI's analytical capabilities are then leveraged to analyze the relationships between air pollution and these factors, enabling the calculation of statistics, identification of trends, and generation of valuable insights from the data, leading to a deeper understanding of the drivers of air pollution. Finally, comprehensive reports are generated to summarize the findings of the analysis, including maps, charts, and tables that effectively communicate the key results. These reports are shared with stakeholders, including policymakers, researchers, and the public, to disseminate the information and inform decision-making processes, contributing to a collaborative effort to address air pollution in the ASEAN region. By employing these methods in Power BI, this study aims to provide a comprehensive and insightful analysis of NOx, SO2, NH3, and CO pollution in the ASEAN region. The interactive visualizations and analytical capabilities of Power BI will enable the identification of pollution hotspots, the assessment of contributing factors, and the development of targeted mitigation strategies, ultimately leading to improved air quality and public health outcomes.

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Figure 1. MAPPING with bubble for Sum of Ammonia by Country

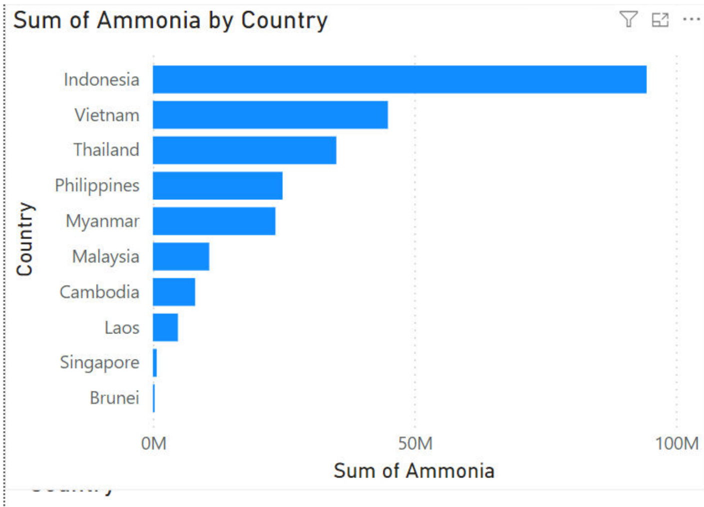

Figure 2. Ammonia of Ammonia by Country

The visualization effectively presents ammonia emissions across ASEAN countries, highlighting Indonesia as the dominant contributor with nearly 100 million in emissions (units unspecified, likely kg or tons). This substantial output likely stems from Indonesia's large agricultural sector, where livestock waste and fertilizer use are major sources of ammonia. The disparity between Indonesia and low-emitting nations like Brunei and Singapore underscores the influence of economic activity and land use on ammonia pollution. This data is crucial for policymakers in targeting interventions, potentially through agricultural regulations or promoting sustainable farming practices, to mitigate ammonia's contribution to regional air quality issues.

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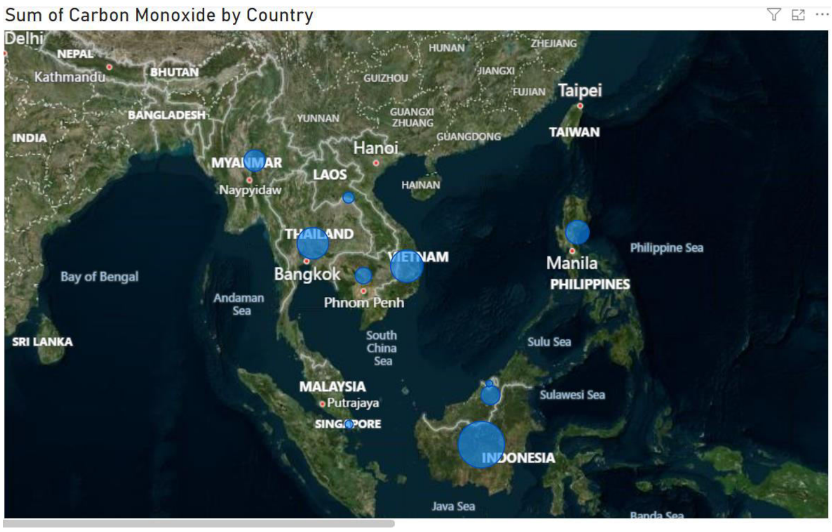

Figure 3. Sum of Carbon Monoxide by Country Geomapping

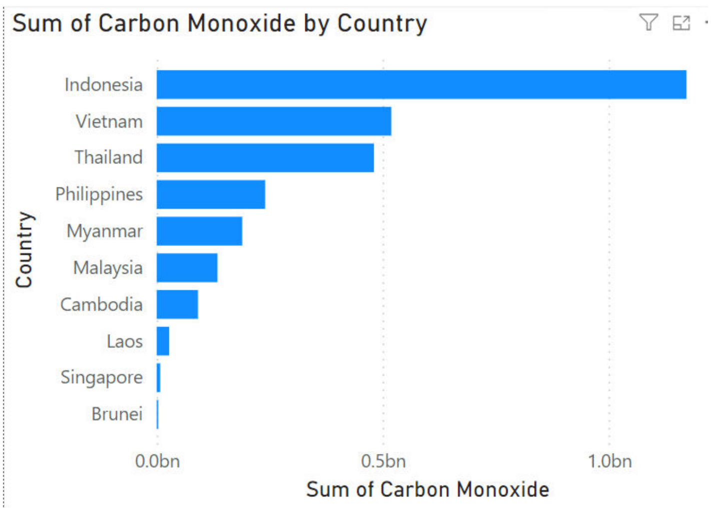

Figure 4. Graph of Carbon Monoxide by Country

This graph shows reveals the distribution of carbon monoxide (CO) emissions across ASEAN countries. Indonesia again takes the lead, emitting over 1 billion units (likely kilograms or tons) of CO, significantly higher than any other nation in the region. This high emission level is likely linked to Indonesia's reliance on fossil fuels, particularly in transportation and industry, and potentially exacerbated by deforestation and biomass burning practices. The disparity between Indonesia and countries like Brunei or Singapore, with minimal CO emissions, points to the influence of industrialization, economic activity, and population density on CO pollution levels. This data is crucial for regional environmental planning, prompting targeted efforts to reduce CO emissions in high-emission countries. Such efforts might involve promoting cleaner transportation options, transitioning to renewable energy sources, and improving industrial efficiency to mitigate the health and environmental risks associated with CO pollution.

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Figure 5. Sum of Nitrogen Oxide by Country Geomap

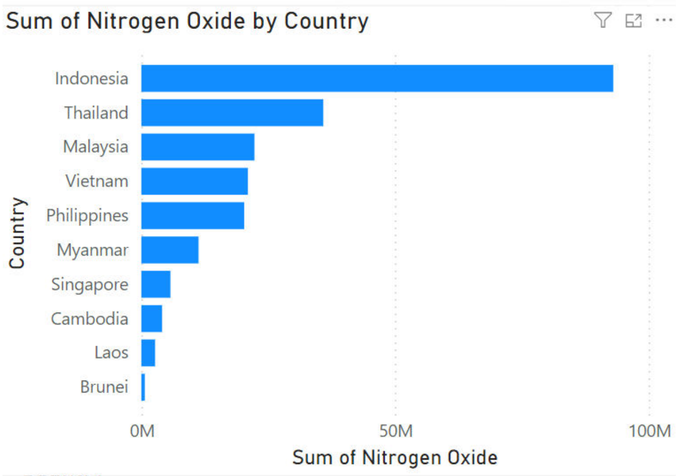

Figure 6. Sum of Nitrogen Oxide by Country Graph

The figure above illustrates the distribution of nitrogen oxide (NOx) emissions across the ASEAN region. Similar to the previous charts, Indonesia emerges as the largest emitter of NOx, exceeding 90 million units (likely kilograms or tons). This high level of NOx pollution is likely attributed to Indonesia's significant reliance on fossil fuels for transportation and energy production, coupled with industrial activities and biomass burning. Thailand follows Indonesia with a substantial amount of NOx emissions, indicating that these countries face considerable challenges in managing air quality.

The lower NOx emissions observed in countries like Brunei and Laos suggest a correlation between NOx pollution and factors such as population density, level of industrialization, and economic activity. This emphasizes the need for tailored approaches to air quality management in the ASEAN region, recognizing the diverse range of emission sources and contributing factors across different countries. NOx emissions have significant implications for both human health and the environment. NOx gases contribute to the formation of smog and acid rain and can cause respiratory problems and other health issues. Therefore, it's crucial for ASEAN countries, particularly those with high NOx emissions, to prioritize strategies for reducing NOx pollution. This might involve implementing stricter emission standards for vehicles and industries, promoting cleaner transportation alternatives, and transitioning to renewable energy sources.

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IV. CONCLUSIONS

This study employed Power BI to conduct a geospatial analysis of air pollution in the ASEAN region, focusing on ammonia, carbon monoxide, and nitrogen oxide emissions. The analysis revealed valuable insights into the distribution and potential sources of these pollutants, highlighting key trends and disparities among ASEAN nations. Indonesia consistently emerged as the highest emitter of all three pollutants, likely due to its large agricultural sector, reliance on fossil fuels, and extensive industrial activities. This underscores the need for Indonesia to prioritize air quality management through stricter regulations, sustainable practices, and investment in cleaner technologies. The disparity between Indonesia and low-emitting nations like Brunei and Singapore emphasizes the influence of economic activity, population density, and land use on air pollution levels. This highlights the importance of tailored approaches to air quality management in the ASEAN region, recognizing the diverse range of emission sources and contributing factors across different countries. The findings of this study have significant implications for policymakers and stakeholders in the ASEAN region. The visualization of pollutant distribution provides crucial information for targeted interventions, such as promoting sustainable agricultural practices, transitioning to cleaner transportation options, and implementing stricter emission standards for industries. Regional cooperation and data sharing are essential for addressing transboundary air pollution and developing comprehensive mitigation strategies. ASEAN countries can collaborate on air quality monitoring, research initiatives, and policy development to effectively manage air pollution and protect public health. While this study provides valuable insights into air pollution in the ASEAN region, it is essential to acknowledge its limitations. The analysis relied on available data, which may have gaps or inconsistencies. Further research with more comprehensive data and advanced geospatial modeling techniques can enhance the understanding of air pollution dynamics and inform more effective mitigation strategies. In conclusion, this geospatial analysis using Power BI has shed light on the distribution and potential sources of ammonia, carbon monoxide, and nitrogen oxide emissions in the ASEAN region. The findings underscore the need for targeted interventions, regional cooperation, and continued research to address air pollution challenges and promote sustainable development in the region. By prioritizing air quality management, ASEAN countries can protect public health, preserve ecosystems, and contribute to a cleaner and healthier environment for all.

V. RECOMMENDATIONS

This geospatial analysis of air pollution in the ASEAN region reveals critical areas for intervention. Indonesia, identified as the major emitter of ammonia, carbon monoxide, and nitrogen oxide, should prioritize stricter emission standards for industries and vehicles, coupled with the promotion of sustainable agricultural practices to reduce ammonia release from livestock and fertilizer use. Investing in renewable energy sources and enhancing public transportation networks are crucial steps towards mitigating CO and NOx emissions. Across the ASEAN region, each country should develop tailored air quality management plans that address their unique pollution challenges and contributing factors. Strengthening regional cooperation through collaborative monitoring, data sharing, and joint mitigation initiatives is essential to tackle transboundary pollution effectively. Public awareness campaigns should be launched to educate citizens about the health and environmental impacts of air pollution and encourage individual actions to reduce emissions. Furthermore, investing in research and technology is crucial to advance air pollution monitoring, modeling, and mitigation strategies. Specific recommendations include promoting the use of electric vehicles and supporting the development of charging infrastructure, implementing stricter controls on open burning and biomass burning, and investing in urban greening and afforestation projects to improve air quality. Developing early warning systems for air pollution events and supporting the development and adoption of clean cookstoves and fuels are also crucial steps towards mitigating air pollution in the region. By taking decisive action on these recommendations, ASEAN countries can collectively improve air quality, protect public health, and ensure a sustainable future for the region.

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