The Relationship Between Traffic Volume, Pollutant Emissions and Traffic Accidents: A Case Study of Shiraz City Entrances

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SUMMARY

In this study, we leverage the synergy between geostatistical methods and machine learning algorithms to analyze the complex interactions among high traffic volumes, nitrate pollution, and road accidents at urban entrances. Specifically, we employ the Inverse Distance Weighting (IDW) method for spatial interpolation of traffic data, enabling a detailed spatial representation across the study area. Subsequently, the Random Forest algorithm, a robust machine learning approach, is utilized to model and predict nitrate pollution levels, incorporating spatiotemporal data from traffic sensors, accident records, and satellite imagery.

Air pollution, particularly from nitrogen-based pollutants like nitrogen oxides (NOx), poses a significant challenge to modern urban environments. These pollutants, primarily generated by vehicular emissions and industrial activities, contribute not only to poor air quality but also to climate change by exacerbating the greenhouse effect. The interplay between air pollution and climate change threatens sustainable development by impacting public health, degrading ecosystems, and increasing the frequency of extreme weather events. Moreover, the rise in traffic volume in urban areas has amplified the risks of road accidents, creating an urgent need to address road safety alongside environmental concerns. Integrating sustainable practices into urban planning, such as leveraging advanced technologies to monitor and mitigate pollution and improve traffic management, is essential for promoting long-term environmental health and safety. These efforts align with global goals for sustainable development, fostering a balance between economic growth, environmental protection, and public safety.

This study explores the intersection of programming, remote sensing technology, and environmental science to address urban air pollution in Shiraz, specifically focusing on nitrogen pollutants (nitrogen oxides). Using remote sensing imagery, the research employs advanced image processing algorithms to detect and quantify nitrogen pollutants at key traffic intersections and city entrances. Traffic patterns and accident hotspots are analyzed in conjunction with pollutant data, revealing a significant correlation between traffic volume, accident frequency, and nitrogen oxide concentration. The research further investigates the role of machine learning algorithms and raster model data in improving pollutant detection accuracy and prediction of high-risk traffic zones. This study contributes to developing smarter traffic management systems that also focus on environmental sustainability.