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A Weighted Index Framework for Optimal Selection of Urban Trees to Mitigate Particulate Matter Pollution in South Korea

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Extended Abstract

Recent research highlights East Asia's industrialization impact, particularly severe Particulate Matter (PM) air pollution in South Korea [1]. This underscores the importance of urban forests, where efficient tree species can be selected based on new formulas that consider plant characteristics and regional suitability.

In international research, the PM reduction abilities of tree species are commonly referenced but have limited insight [2]. Especially in South Korea, the nuance of species performance has been overlooked [2]. Moreover, another research case analysis of seasonal reduction provides a limited scope of the survey area [3]. These studies emphasize the need to consider regional suitability and plant characteristics to mitigate urban air pollution.

The approach prioritizes assigning weights to three key factors: species' PM reduction capability, tree planting region, and exact location. The newly developed PMI (Particulate Matter Index) is to select trees with good PM reduction capabilities in South Korea and then classify them according to their capabilities [4].

Each tree is assigned a Regional Index (RI) and Place Index (PI). RI signifies the optimal climatic conditions for tree growth. It is subdivided into climate zone(C) [5] and humidity(H), and scores are assigned compared to the climatic environment of each region of South Korea.

The Place Index is used to evaluate the environmental suitability of tree species for urban planting based on factors that affect humans after planting and interact with the local environments. The variables are as follows: T (Toxicity), representing the potential impact of tree toxicity on humans; A (Allergic), the degree of allergen presence; S (Stink), indicating the presence of foul odors in areas with human activity; R (Reduce Temperature), indicating the ability of trees to mitigate urban temperatures; and APT (Air Pollution Tolerance), the resilience of trees to survive in areas with air pollution, with assigned weight values for three types of areas.

These criteria allocate varying weights depending on the characteristics of three distinct locations: residential areas, traffic areas, and industrial areas. In residential areas, R carries the highest weight, as there exists a significant relationship

between residential areas and air temperature [6]. Additionally, as the dispersion of PM and the decline in urban air quality in both traffic and industrial areas intensify, APT increasingly influences each aspect of the equation [7]. As the structured weighting system, PMI held the highest weight, followed by RI and then PI, in sequential priority. This enabled the selection of tree species suitable for diverse regional and urban needs.

The framework incorporates detailed characteristic-based criteria, including floral presence, deciduous or evergreen status, fruit-bearing ability, fragrance, broadleaf or coniferous distinction, and height. These criteria allow users to select based on personal preferences and aesthetic sensibilities.

The expected outcome involves the identification of tree species that are effective in reducing PM air pollution in urban areas. Through the integration of multiple criteria, we aim to develop a platform for enhancing the efficiency of urban forest initiatives by utilizing a configured methodology and accessing diverse databases. Ultimately, this resource will empower local governments to create healthier, more sustainable environments.

Keywords: Air pollution, Particulate Matter, Tree species selection, Regional suitability, Environmental suitability

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