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Carbon Management Requiring Index: The Scientific Decision-making Tool for Urban Green Management

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Recently, most cities have opted for urban greening as a way to mitigate climate change. However, the urban characteristics, such as the fragmented land cover and harsh environment hard to maintain vegetation healthy, reduce the efficiency of greenery. Therefore, a continuous and scientific management tool is required to mitigate climate change through urban greenery. In this study, we developed the decision-making tool, CMRI (Carbon Management Requiring Index), which can identify the area with low carbon sequestering performance and propose the priority for the carbon management requirement. The index was determined by integrating five parameters; 1) terrestrial carbon storage, 2) terrestrial carbon uptake, 3) soil texture, which implies the capacity for soil carbon sequestration, 4) green area ratio, which means that the chance of carbon management, and 5) landscape context, which represents the edge effect by the adjacent urban landscape. The three parameters of terrestrial carbon storage, green area ratio, and landscape context were estimated based on the 0.25 m land cover map using satellite data through machine learning. The terrestrial carbon uptake was determined by the data-driven model through satellite measurement data. Lastly, we acquired the soil texture data from ISRIC – World Soil Information dataset. We normalized each parameter with the z score method. We applied the index in our test site (Suwon, Republic of Korea), and we mapped CMRI with its spatial resolution of 30 m x 30 m considering the resolution of each parameter. The CMRI values had a gradient which showed the high management demand in the city center and the relatively low in the forest interior. The range of CMRI values was from 0.2 to 0.8. To suggest the priority of carbon management requirements, we divided the CMRI grids into four quarters, low, medium, high, and extremely high. To verify that CMRI represents the carbon management requirement level properly, we plan to validate it by field observation. Three grids in each priority level will be selected to measure the vegetation condition, including DBH and chlorophyll-a content, and soil characteristics, including soil texture, soil carbon stock, and soil respiration. Through principal component analysis (PCA) using field measurement results of the grids, we can weigh each parameter and make the index more accurate.