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GIS-based multicriteria decision analysis for the environmental assessment of the Pesqueria River in Northeast Mexico, using UAS and multi-spectral imagery

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Urbanization is the dominant force shaping social, economic, and environmental life in the 21 century. Urban areas will become essential to achieve the Sustainable Development Goals (SDGs) established by the United Nations in their 2030 Agenda. Local governments must identify the vulnerable ecosystems to make cities inclusive, safe, and resilient (SDG 11). In Latin America, urban rivers are vulnerable ecosystems, negatively impacted by rapid urbanization. Furthermore, detailed geospatial information of urban rivers is not updated frequently, therefore available data doesn't reflect changes occurring due to rapid urban development processes affecting the quality of water, sediments, or vegetation health. This research uses a GIS-based multicriteria decision analysis (GIS-MCDA) for the environmental assessment of the Pesqueria River as a decision tool to facilitate mitigation focused strategies. The developed method has used the pixel to pixel data from socio-economical, environmental, topographical, geological, and hydrological factors affecting the environmental health of urban rivers. Census data, geological formation or soil type were obtained from official information; reflectance indices and vegetation height were obtained using aerial photogrammetry with near-infrared and red bands; terrain and hydrological analysis used digital elevation models derived from LIDAR; land cover was created using a SENTINEL 2 image; and water quality data was obtained from field sampled raised and analyzed with traditional laboratory analysis of Chemical Oxygen Demand and validated also with official data. Results implied the generation of the thematic maps with ranges from 1 (very low quality) to 5 (very high quality) according to the environmental quality assessment. For the GIS-MCDA, the values of each map were converted to the same scale, each criterion was weighted in function of its importance according to the literature review and the objective of this research, and there were aggregated by the way of a lineal combination. The result is a map that shows the level of mitigation or conservation priority along the river. This map can offer information to the stakeholders in a relatively short time and accelerate the actions aimed to protect the quality of this important urban ecosystem.