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«Infrastructure and Construction Project Management»

Postgraduate Diploma Thesis

Fund Allocation for Upgrading Flood Safety Measures

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Abstract

Floods are natural phenomena with serious consequences for human existence, infrastructure and the environment. In the framework of climate crisis combined with the problem of urbanization, strengthening resilience of cities against floods is a primary concern of urban planning and disaster risk management.

This study aims to develop a model capable to optimally allocate the financial resources with the scope of improving the level of flood protection in urban areas. A methodology that combines multi-Criteria Dimension Analysis (MCDA), using the Analytic Hierarchy Process (AHP), with a set of meta-heuristic optimization algorithms, including Genetic Algorithm (GA) and Particle Swarm Optimization (PSO) of which additional emphasis will be given, is presented. The result of this approach is the development of an index called the Flood Resilience Index (FRI), which quantifies the contribution of flood protection measures to enhancing cities' resilience against floods.

The proposed model is applied to a case study involving an area of 2.72 km2 in the Municipality of Ilioupoli, in Greece. For this specific area, the implementation of five flood protection measures was examined. These measures are the following, water drainage networks, mobile protection measures, green roofs, permeable pavements, as well as the development of an early warning system. The current situation is assessed and the level of implementation of these measures is being evaluated. Subsequently, the cost of implementing and improving the proposed measures is estimated, as well as their contribution to enhancing resilience.

Based on the data collected, the results of two different optimization problems are presented. In the first problem, a set of 20 different budgets is examined with the aim of achieving the optimal FRI index through partial implementation of the proposed measures. In the second problem, 19 different FRI objectives are examined and the minimum budget required to achieve them is calculated.

The results demonstrate the potential for applying a wide variety of optimization techniques during the decision-making phase in urban planning and protection. The proposed model enables stakeholders to better understand how available resources can be allocated according to the objectives set for urban flood resilience.

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