**The flood risk changes effective factors in Tehran Metropolis**

**Extended abstract**

Floods in urban areas have become more and severer with the rapid growth of urbanization and the creation and development of infrastructure. Expansion of urban construction and surfaces with low permeability reduce the rainfall infiltration and groundwater recharge and increase the runoff, larger discharges and variability. Urban flooding is the result of natural processes as well as anthropogenic activities. The land use changes in urban area including the expansion of commercial, residential and communication networks profoundly affect the urban water cycle mechanism (precipitation-runoff process). Ignoring the natural factors in spatial planning, overrun and destruction of natural morphology as a result of urban activities and subsequently disturbing urban drainage system lead to unpredictable and destructive floods in Tehran.

Tehran’s floods have complex behavior due to the amount of change or destruction of the urban natural watercourse, how to implement the roads network patterns (northern-southern or eastern-western direction), type of land use, various densities of urban fabric and non-uniform distribution of population, and even the level of socio-economic and quality of life in urban neighborhoods of Tehran metropolis. In this study, the risk map as an index to define the said complexity was prepared in 5 categories of risk by combination of Tehran metropolis flood hazard and vulnerability maps.

To analyze the risk varieties, the hydrological catchments of Tehran were extracted by Arc Hydro model and 12 catchments were selected. Using land use, roads network, and the percentage of residential floor area, bridges, altitude, slope and drainage density variables, the flood hazard map was calculated. Dilapidated urban blocks, population density, land use, bridges, slope and drainage density layers were used as variables which affecting the flood vulnerability. Covariance index was applied for matched variables and considering the locational coherence between the values of them. Based on the new raster layers, flood risk variability in Tehran metropolis as well as in each of the catchments were analyzed using stepwise regression model. Explanation of locational changes of risk between the catchments needs to calculate the weighted average risk and the independent variables in 12 catchments that obtained by zonal statistics. Based on these average values the factor analysis used to determine the varifactors or main components of the variability in flood risk between the catchments. Finally, fractal geometry models (perimeter-area and cumulative number-area) were used to demonstrate the chaos of the flood risk value in 5 categories of risk.

According to the flood hazard zoning map of Tehran metropolitan area, the extent of ​​high hazard zone is 129.6 square kilometers. High risk zone covers 28.6% of Tehran's area, indicating that most of the city's extents (174.4 square kilometers) are located in the high flood risk zone. After that, the moderate hazard zone is 28.5% of the city area. Very low zones with 3.53% of the total area are the smallest zones in the city, which are only 21.5 square kilometers. Overall, 78.3 percent of the total area of ​​the city is located in the moderate to very high zones of flood hazard, reflecting Tehran's challenge to flooding. The vulnerability map defines that 138 km2 of the Tehran city area is located in high and very high zones of the flood vulnerability. According to Tehran metropolitan flood risk zoning map, 163.1 km2 of Tehran city area is located in high risk zone which has the highest rate among flood risk categories in Tehran metropolis (26.9%).

The final purpose of this study was to use the flood risk map as an indicator of flood behavior in Tehran metropolis. An index that using the nature of dependency, can measure the role of independent variables in different parts of the city in relation to its flood spatial variability. This variability and risk relationship with independent variables were measured in the sample catchments, which represent different sections with specific characteristics in Tehran. The results of this study illustrated that the risk as an indicator of flood behavior in Tehran metropolitan area is not constant. It has been observed in various sections that this unstable spatial distribution is due to differences in Tehran's urban indices, of course, with respect to the natural context of the city. The combination of these natural and urbanization indicators in diverse parts of Tehran creates a different pattern of flood risk that raises the issue of flood chaos (especially unpredictable short-term floods). The results of factor analysis based on the average weighted of flood risk index and its effective variables revealed four influential factors in the spatial risk changes in the 12 sample catchments. The first component, with justify of 31.8% of the total factor variance and with a specific value of 0.79 (relationship of flood risk to independent variables) as the main component in flood risk variations between the watersheds, is identified the worn-out textures, population density and percentage of residential area variables as the factors of flood risk variability among the sample catchments. Therefore, worn-out texture, residential infrastructure, and population density cause the floods variability at the levels of 12 samplecatchments and consequently at the level of Tehran metropolitan area. The worn-out textures cause flooding intensification and even flood initiation due to the lack of proper drainage, as well as the watercourse networks in these areas.

**Keywords:** Food risk, Worn-out texture, AHP, Factor analysis, Tehran