

INTEGRATED FLOOD MANAGEMENT IN TEHRAN USING GIS AND REMOTE SENSING

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ABSTRACT

Problem Statement: Tehran, capital city of Iran with an area of 620 Km², is located in south of Alborz chain. It has a large difference between the elevation of its north and south, irregular distribution of precipitation besides the impervious land and population are increasing. Therefore the flood disaster has become a vital problem in Tehran. Due to the flattening of the urban land, landuse changes and developing of the urban transportation, the drainage system was become useless. This study was purposed a hydro-geomorphic zoning method for the flood integrated management in Tehran. Materials and Methods: The elevation data was taken out from the Topographical maps 1:25000, climatic data from Synoptic stations and landuse from ETM images of Landsat 7 satellite. The map of the present tunnels network was obtained from Tehran municipality. Then the data was corrected by field researches and analyzed by HEC-HMS and Hydro Model (Agree DEM).Result: 7 hydro-geomorphic main and some small zones were extracted in Tehran .Each zones is equal to a basin which has a drainage network. Conclusion: The comparison of the results with the path of present tunnels showed that the last flood has passed through the zones' center line instead of present tunnels in Tehran. The hydro-geomorphic zoning method is able to manage flooding in metropolis, furthermore warn the happening of floods.

Keywords: Flood, Tehran, HEC-HMS, Hydro Model

Introduction

There are many events of flood through the world spatially cities which are in dry and mountainous region. In this field most countries are drawing up a strategy to control an urban flooding. These strategies are related to maintain the drainage systems, mend center line of basins, and prevent developing unsuitable landuse; like as Zambia government and WMO have approved a strategy which was called Integrated Flood Management (IFM) (Mwelwa, 2008), Municipality of Dordrecht in Netherland has stabilished a policy which was named Urban Flood Management (UFM) to mänge flooding (Waals and Kelder,2008) and British Colombia in Canada has changed the flood's policy because of so many damages of flooding (Lyle, and Mclean,2008).

Due to bare lands, co-incidence of snowmelt and rainfall, irregular spatial and temporal distribution of precipitation and so on, flash flood is happening in the most regions of Iran during autumn and spring. Tehran is a capital and metropolis city of Iran which is located in southern slope of Alborz chain(fig1) . Tehran has been grown during 20past years and now its area is about 620 Km².Besides it is concluded some small northern-southern basins. These basins drain north of Tehran to south on the other hand Tehran's municipality has developed bottom lands of the basins to manage run off.Because of flathering ground , Divided line of the basins has been destroyed, so the bottom lands cannot control the runoff . Consequently Tehran is not able to gather the runoff during the intensity rainfall; thus flood phenomena are frequent in Tehran (Ghohroudi.Tali.2008,a).

Since flooding is created within the framework of the hydro-geomorphic system, it cannot be managed just by maintenance of bottom lands (center lines). A hydro-geomorphic system needs all its components in order to control its run off. Therefore detection of flood ways in urban area should be done by attention of system elements. In this research Tehran has been zoned base on the system theory to define more efficient flood ways.

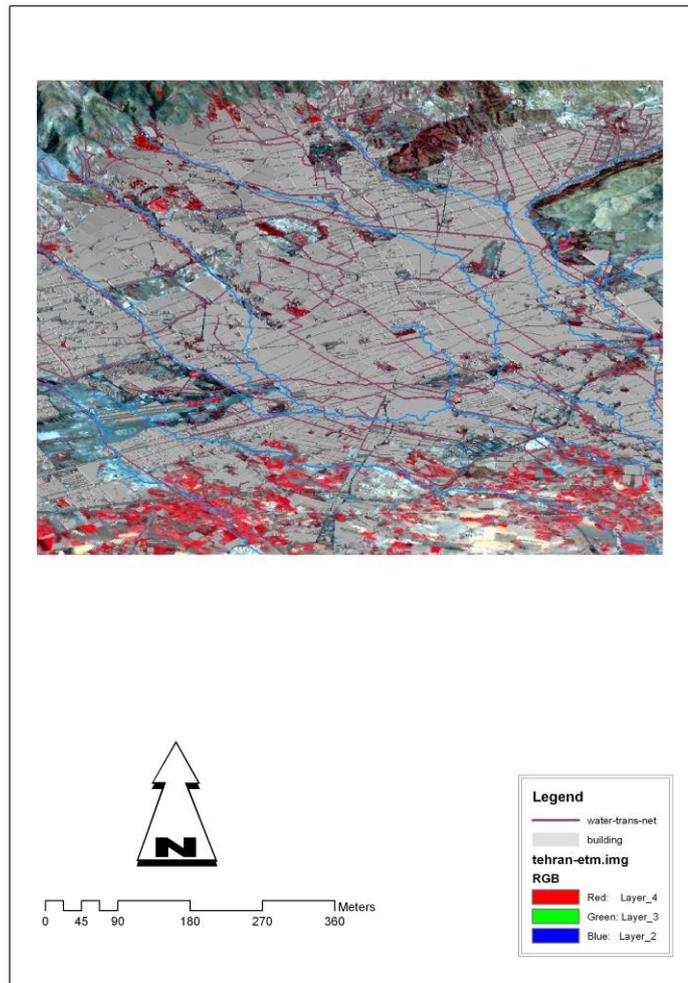


Fig1: Tehran's situation

Data and Method

In order to detection of flood ways in Tehran the following steps were taken.

- 1- Digital elevation model was built base on digital topographic data. The DEM was analyzed by Hydro Model in ArcGIS in order to zoning. 7 main hydro-geomorphic basins and some small zones were extracted in Tehran. Drainage lines and drainage points of the basins were evaluated during the analyst. The elements of hydro systems were coded individually. The above parts of zones were adapted to north of Tehran that's why the ground have not flatted yet. Figure 2 dispys the basins were obtained and Tehran was overlapped on it.

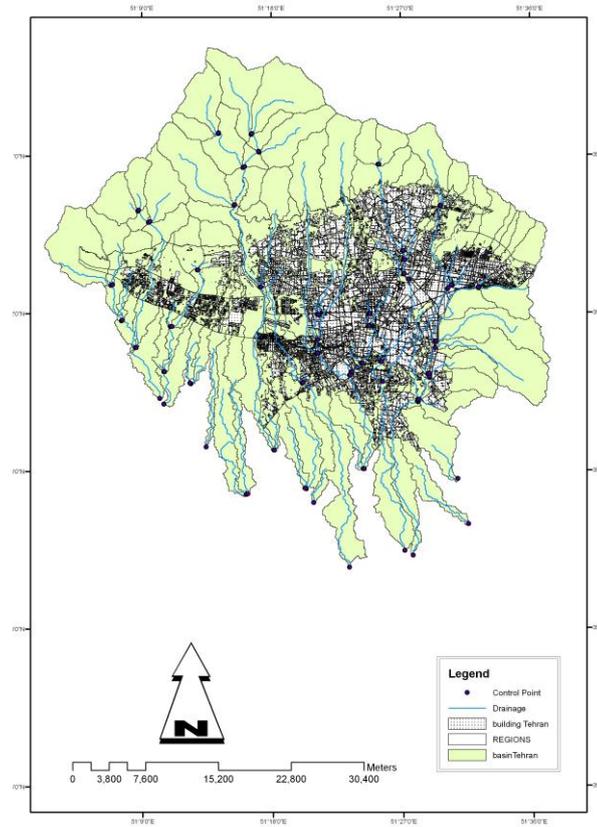


Fig2: Basins of Tehran

2- Drainages network layer (dwg format) of Tehran was received from Tehran's municipality and completed with Centerlines of the basins which were extracted from ETM images. These networks which Fig 3 shows a part of them were compared to the basin's elements. Most drainages were not in conformity with centerlines in the first step.

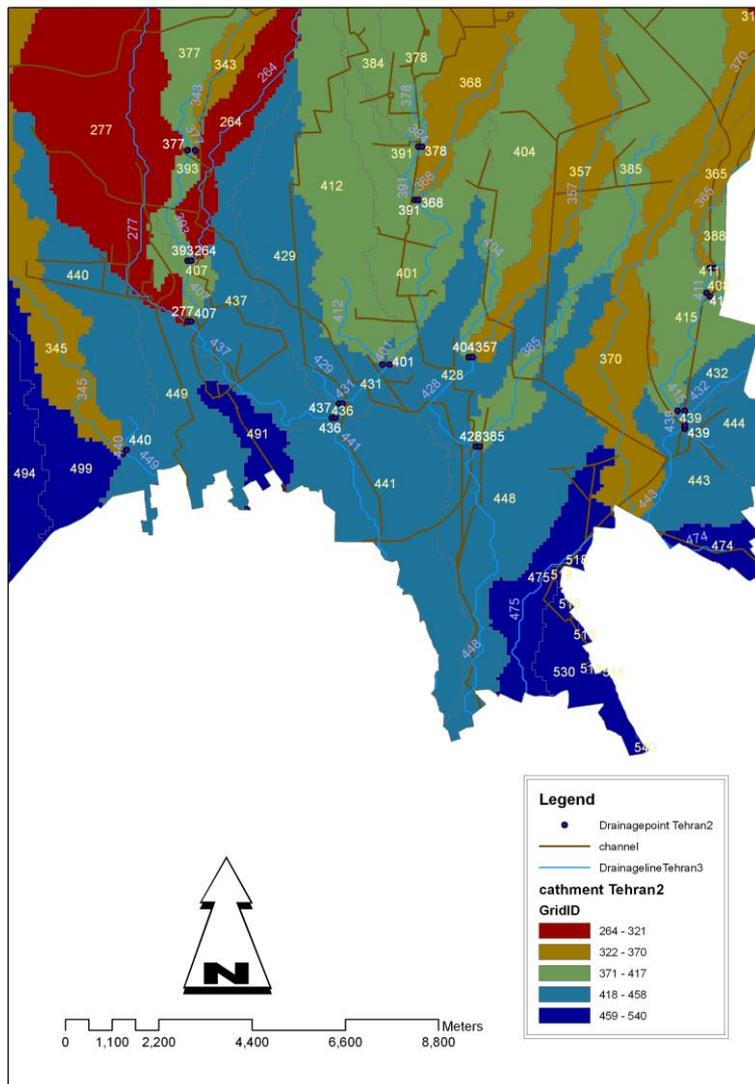


Fig3: Compare Drainage System and Present Channel in Tehran

- DEM of Tehran was burnt by Drainages network via Agree Method in order to assess their ability of gathering and leading the runoff. These channels were not able to detect sub basins, drainage points (fig4).

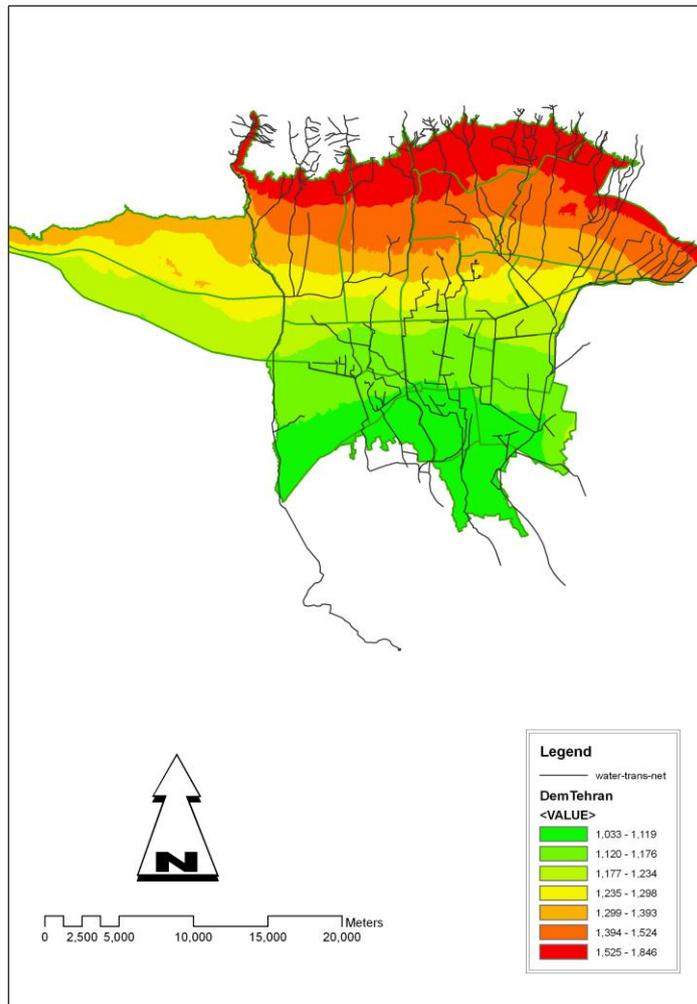


Fig4: Present Channels on DEM of Tehran

- 4- Streets and highways network were overlaid on the database to recognize relationship between channels and physically urban elements. Fig 5 shows most highways in Tehran are extended from west to east. Field research confirmed expanding the runoff in the entire city by the highways and streets. In the other words texture of the roads has increased irregularity of the hydro-geomorphic system.

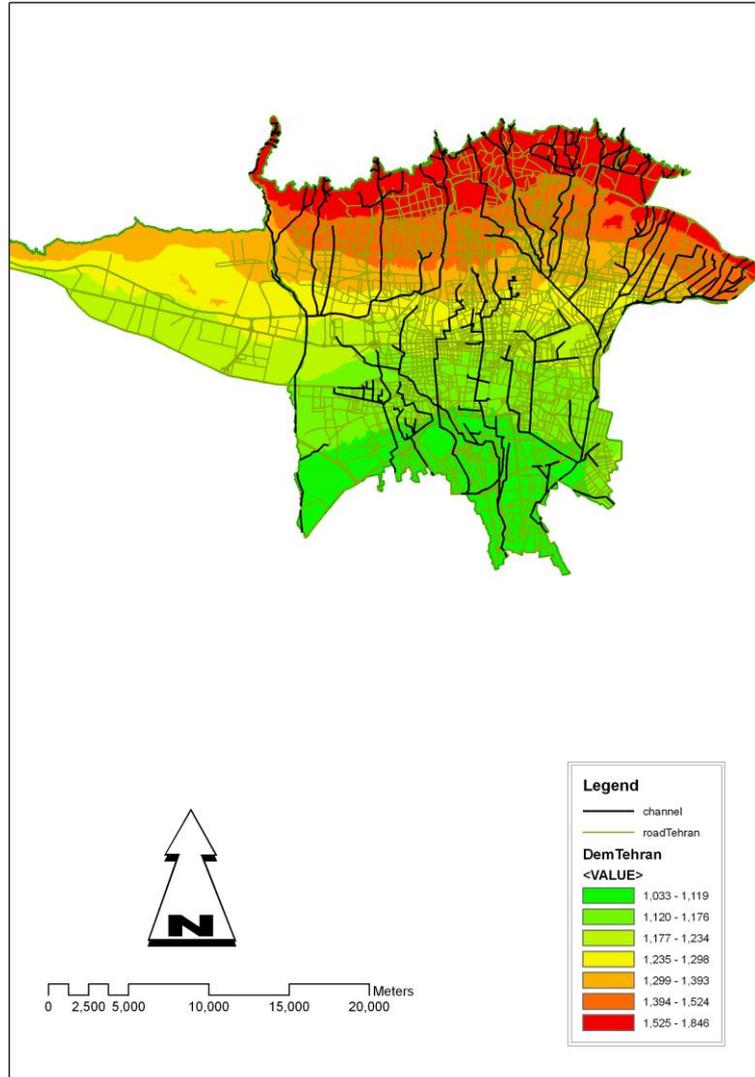


Fig5: structure of network in Tehran

- 5- All the layers were analyzed to detect drainage system again, base on the centerlines (step1), the drainage network (step2, 3), the streets and highways (step4) and the buildings by HEC-HMS, Hydro Model and field researches. So a geodatabase which consisted sub basin, centerline and control point was built and their spatial and attribute relations were defined among them. These unites can connect to time series and warning systems (fig6).

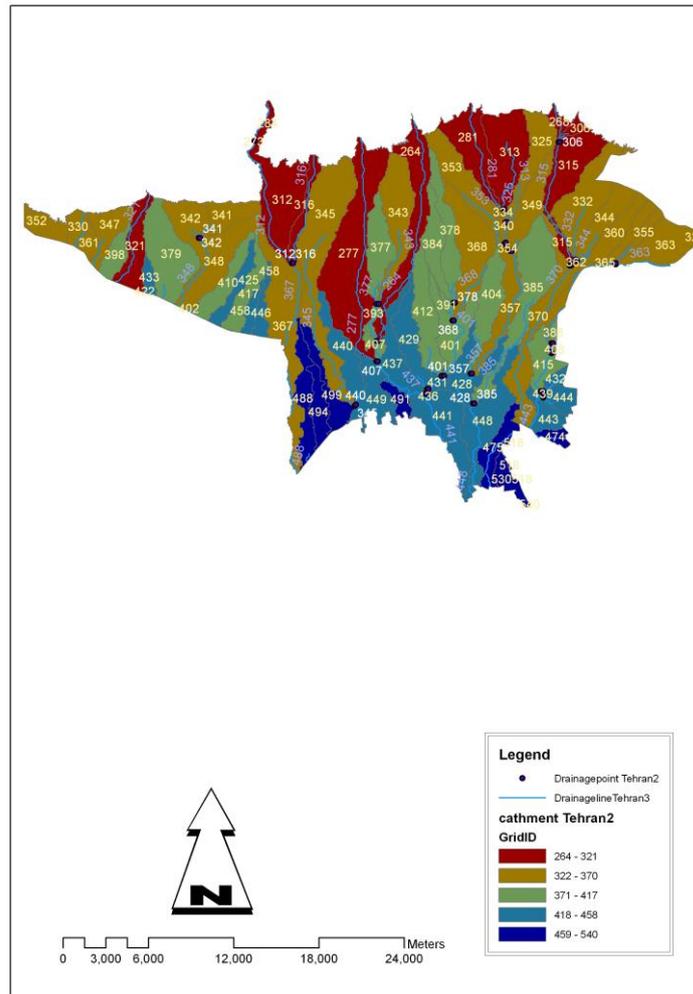


Fig6: Gathering Runoff Units in Tehran

Conclusion

Tehran as a capital and the largest city is important to Iran's policy. Its Situation in southern slope of Alborz chain, growing of population and expanding area are causing difficulty of Tehran protection against flood. The results of this study showed that the present channels are adaptable with real centerlines just in Tehran's North. Its center and south have many problems to gathering and leading the runoff. Hydro-geomorphic units of Tehran were extracted with threshold of 400 cells (50*50 Meters) and their centerlines were determined. A mouth was defined for each unit to control run off. These layers were compared with the present channels, Street, highways and landuse of Tehran. Lake of according between the real networks and present networks displayed that present drainage cannot drain Tehran during the intensity rainfall , spatially in center and south of it. As a result water flow in streets and highways instead of channel and cause urban flooding in Tehran. Existence of density building adds more irregularity to control flooding. In a conclusion the first Tehran needs to determine hydro-geomorphic zones with small threshold. The second their elements and relationships must be defined base on all natural and man-made components. Therefore Tehran will have a geodatabase to

integrated manage urban flooding. At the last it is very critical to prevent expanding of Tehran to the North which is the only virgin places.

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