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Research Article

SURVEY THE EFFECT OF LAND USE CHANGE ON CATCHMENT HYDRAULIC RESPONSE (CASE STUDY CHEHEL CHAI BASIN)

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ABSTRACT
Urban development, industrialization and land use change has a negative impact on catchment hydrology, which intensifies flooding, increased pollution in coastal areas, reduced base flow and ground water recharge. In this study, to evaluate the impact of land use changes on the hydrological response of a basin Chehel chai and increase flood risk model HEC-HMS hydrological used. Statistics show that changes in forest areas to agricultural lands during years 1351 to 1388 in this area has led to 2537 acres of forest to agricultural land to be converted .ON this model for scenarios increased by 11 and 13% of agricultural land (and the same proportion of forest decline) run and a flood peak flow before changes in land use and then were compared. Finally, according to the results of the model showed that the cultivated land area increased by 30% (equivalent to a reduction of 30 percent of forest) up to 6% and 6 % of the size of the flood peak discharge of floods will increase.

Keywords: *Chehel Chai, Flood, HEC-HMS, Use Change*

INTRODUCTION
Nowadays, with the development of urbanization, urban flood management issues are further considered. Deforestation and destruction of vegetation reduces soil infiltration capacity and increase the capacity of the drainage basin, which consequently leads to an increase will flood discharge (Kirch, 2002). Extensive flooding in urban basins, causing great financial losses and adverse effects inappropriate and destructive geomorphology and ecological values of natural and urban basins (Erickson *et al.*, 2013).

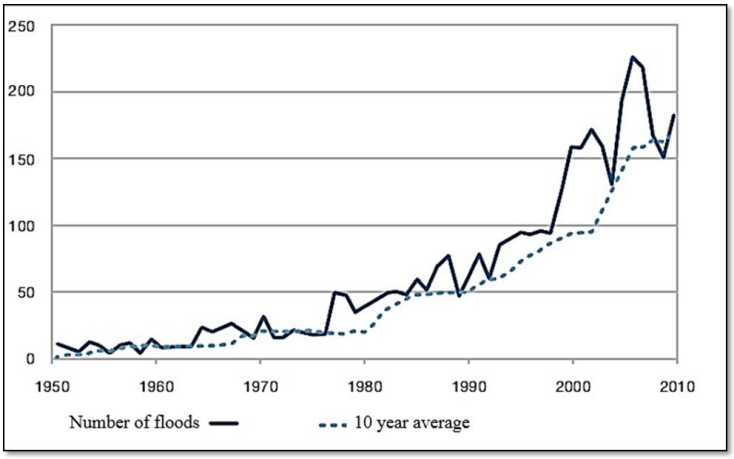

Figure 1: The flood of reports based on EM-DAT/CRED (Erickson *et al.*, 2013)

Hydrologic impacts changes in land use and vegetation management in the form of runoff depth, minimum flow, maximum flow, soil moisture and evapotranspiration appear (Sikka *et al.*, 2003).

Planning and management of natural resource and environmental awareness in relation to land cover changes and causes it to be necessary. Urban development in river basins become non-Urban to urban land use change as a result of normal statue (forest and pasture) to urban (residential, industrial, commercial, sports Roads and pathways) or in agriculture, has increased the flood damage in recent decades (Habibi, 2012).

Only in the year of 2010 close 187million people affected by flooding and the damages caused by it. The amount of damages in exceptional years like 1998 and 2010 totalled 40 million dollars. According to the report released by the World Bank with the name a comprehensive guide to an urban flood management in the twenty-first century as a result of several factors, including a change of land use and urban development the number of flood greatly increased that occurred under this graph reflects the increased occurrence of floods in 1950-2010.

According to official statistics, Iran is among the countries with extreme flooding (Figure 2). Also catchment Chehel Chai within year's witness the recent devastating floods have been caused by the intensification of land use change is proposed (Sharifi *et al.,* 2002). The number increase of floods and flood disasters in Iran shows the need to investigate the reasons for this increase.

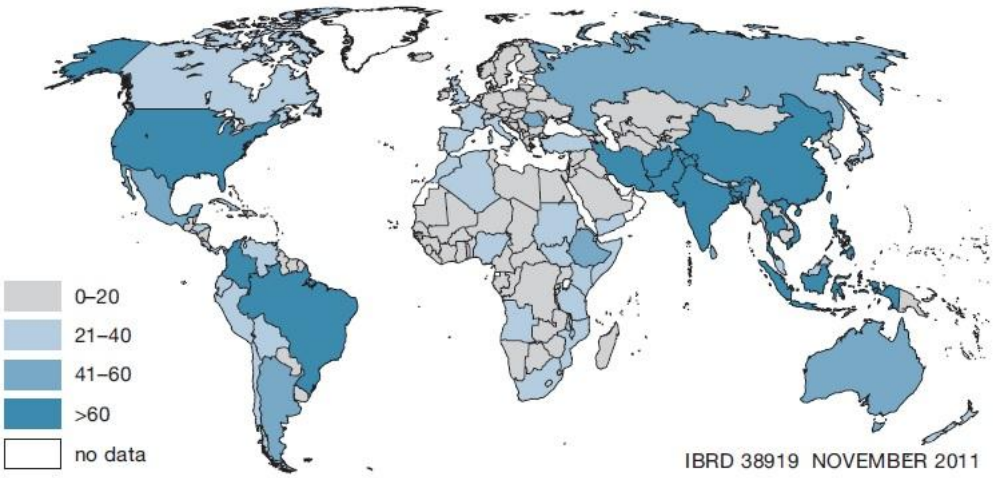

Figure 2: The number of reported flooding in various parts of the world (Erickson *et al.*, 2013)

Urban development into the rivers and watersheds from rural to urban is due to change use of normally (agriculture, pasture and forest) to urban (residential, industrial, commercial, sport, and roads and streets) on flood damage has increased in recent decades. Using mathematical analysis can show up to four times the peak flow during flood compared to the situation before the rise of urban development (Lamond *et al.*, 2011), Among the studies, it can be noted that in 1999, Schultz studies examined the effects of land use change and increasing urbanization of the flood hydrograph. Catchment studies, Nimes River were from Rhine river basin .In his study, satellite images and maps of the terrain can be used. He also simulates the process influence of Green-Ampt infiltration equation used. The three reference scenarios land use change in terms of increased urban planning, land use change from forest degradation can be used both as a result of land use change for the worse acted flood conditions (Schultz, 1995).

Garcia and Associates in 2008 to evaluate changes in water level continuous process models using HEC-HMS. Therefore, catchment Cantabria in Spain was selected for this study , as well as to estimate the input parameters model of Geographic Information System (GIS) was used .Sensitivity analysis was used for calibration of the model Calibrated in order to replicate the total volume of runoff hydrograph shape was done .

In the study period of three Quarterly, six monthly and annual analyzes using the results showed that the runoff coefficient from 51% in a small basin to 67% for large basin is variable (Garcia *et al.*, 2008).

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Introduction to the Study Area

The study area was Goganrud great domain, name Chehel Chai is known. 3 units in this area Hydrological or soil classification are minimum altitude of 139 meters and a maximum height of 1932Meters from the sea. Study area is located between 550 23 to 550 38 east longitude and 360 59 to 370 13 north latitude Watershed area is 25683, 12 acres. Watershed Chehel Chai main streams with the general direction of the South to the north to collect rainfall. The figure below shows the geographical location of the basin Chehel Chai

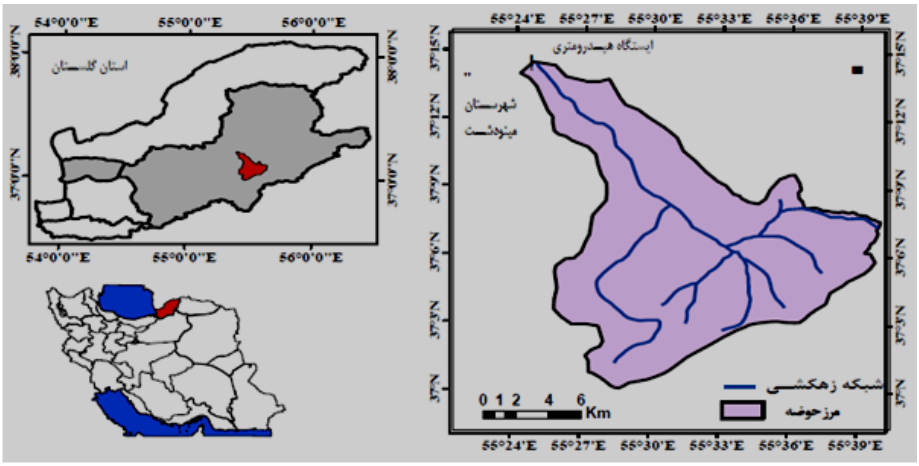

Figure 3: Geographical location watershed (Erickson *et al.*, 2013)

MATERIALS AND METHODS

Land Use Change Statistics

We watershed Chehel Chai ,is considered as one of the most critical area of Golestan province and lower levels of land use change Forested areas .The figure below shows the type of land use in the basin is Chehel Chai.

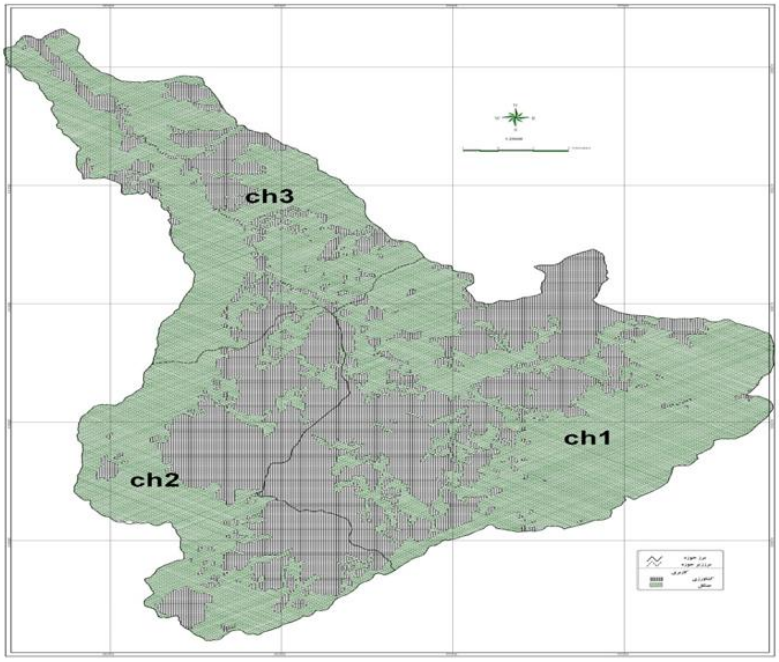

Figure 4: Land use in the basin Chehelchae

Table 1: The area of land in four different classes

2009 years		2000 years		1987 years		1972 years		
Percent of area	**Area (ha)**	**Percent of area**	**Area (ha)**	**Percent of area**	**Area (ha)**	**Percent of area**	**Area (ha)**	**User classes**
56/27	14450	56/81	14589	58/9	15127	66/15	16987	Forest
43/73	11230	43/19	11091	41/1	10553	34/85	8693	Agriculture
100	25680	100	25680	100	25680	100	25680	Sum

According to statistics provided, 3 different scenarios have been considered .In the first scenario the situation according to the latest data (year 1388) considered scenarios in second and third , respectively, increased by 15 and 30 percent considered agricultural land.

Hydrological Modeling

The following figure shows a view of the basin in the software environment.

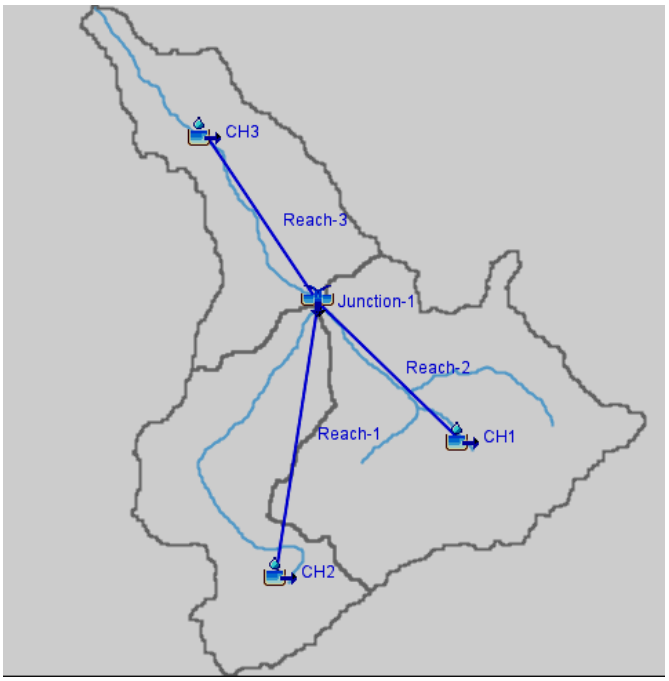

Figure 5: A view of the basin in HEC-HMS

The Parameter Estimates of the Casualties

SCS curve number model celebrity excess rainfall rate as a function of cumulative rainfall, humidity, vegetation and land use the previous expression basin territory. In the great basin, which usually consists of a variety of soil and uses, it is necessary to set the composite curve CNc is calculated by the conjunction (1) (Davis, 2000)

$CNc = \Sigma Ai\ CNi / \Sigma Ai$

A different scenario (table 2) and the amount of CN shows calculated compound.

Table 2: Composite CN values for different scenarios

Scenario	Account Type		The compound CN
	Forest	**Agriculture**	
1	56/27%	43/73%	65.5
2	41%	59%	69.1
3	26%	74%	72.8

Runoff Parameters

Scs curve number method to estimate runoff parameters are used .This method is based on the average hydrograph Small agricultural watershed unit is built in America .The parameters needed for this method is that the time delay by definition is the center of the interval precipitation peak time .Latency of scs and the relationship The following table has been calculated.

$t\ l\ a\ g = L\ 0.8\ (s+1)\ 0.7/1900\ y\ 0.5$ (2)

In this regard tlag basin lag time in hours , L along the main river in feet , y average basin slope (percent)and s profile moisture retention by the soil within the basin) inches (that is , its value is equal to: $s = 1000/\ C\ N\ -10$

Table 3: Physical characteristics of the basin

Average slope (percent)	Maximum height under the basin (m)	Minimum height under the basin (m)	Throughout the basin (km)	Area (km)	Sub-basin
12	1510	185	21/39	118/82	1
18	2140	550	19/31	71/26	2
23	2450	550	19/71	66/75	3

Base Flow Parameters

To estimate, the parameters of a fixed monthly base rate is used. Due to being located Eslam Shahr downstream of Ken basin, a basin of data recorded at the Mehr Abad airport station is used for the values of base flow. Maximum average discharge annual basin is 2/5(m3/s), which was included in the model (Khyrfam *et al.,* 2011).

Rainfall Parameters

Temporal distribution of rainfall, showers hypothetical scs method is used. Showers method scs hypothetical rainfall events observed the four synthetic rainfall distribution developed by the Natural Resources Conservation Service (NRCS) is the uniform distribution .The average annual rainfall amounts in the catchment area are given in the table below.

Table 4: The average annual rainfall (mm)

The average annual rainfall (mm)	Sub-basin
707/6	Ch1
715/9	Ch2
798/5	Ch3

After modeling and implementation flood basin at the 3 -state outputs have been achieved in accordance with Table 4.

Table 5: Flood basin outlet

Scenario	Number Curve (CN)	Peak discharge (m^3/s)	Output Flood size for 2 days (m^3)
1	65/5	1887	14756080
2	69/1	1942/8	15216020
3	72/8	1995/3	15659120

Conclusion

Changes in land use in the basin of Chehel Chai indicate that in the period from 1972 to 2009 due to deforestation and pastures, cultivated land area increased by 9% to a substantial part of it located on steep slopes and are effective in increasing the runoff area. In the same period, the total forest area of 16,987

acres falls by 14450 acres. Thus, about 10 % of the forested land area is low. Changes in land use from pasture forest farming can increase the severity of flooding .In the area of agricultural land at a rate of 30%, a 6% rate flood peak increase. The flood volume output 6% on the first day of the basin, rainfall increases .The fearsome flood in the field of Chehel Chai could not only because of the destruction of the woods and the spatial distribution of the rainfall depth and time-in the production of the big flood in this area play an important role.

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