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**PREPARING CURVE NUMBER MAP WITH RS AND GIS (OPTIONAL STUDY OF
MAHAMMAD ABAD WATERSHED AREA)**

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ABSTRACT

Nowadays to estimate the runoff of watershed the geographical data and remote measurement is used because the precipitation models include both changes of geomorphology and locational. In this project the use land maps of region include 6 classes of agriculture, jungle, barren land, pastures, gardens and residential lands which with satellite images of Landsat 8 in 2013 was prepared then the maps of soil hydrological groups of the area were prepared. To determine the curve number Sara tool in GIS environment was used that height and volume of runoff is presented based on NRCS. Curve number map is prepared of combination land use map, sub area map and maps of hydrologic groups that as a result maps with smaller units achieved which each small unit contains a hydrologic group with determined use. Due to the result of this research the most and the least quantity of estimated curve number for the considered area are in following order. The maximum curve number belongs to barren lands and residential and the minimum belongs to jungles.

**Keywords: U se lands, soil hydrological groups, remote measurement, runoff, NRCS
method**

INTRODUCTION

Since the forecasting issue and the estimation of runoff produced of atmospheric precipitation and the less perception of different production processes is counted as one of the basic and fundamental topics in hydrology science, therefore access to its amount of quantitative and qualitative with the systematic attitude in this respect is important that has formed foundation and base of constructive study plans on different ground of development and exploitation in water sources and water constructions and or other environmental fields in the watersheds. [1]

A common method of runoff measurement in Iran because of not being the most watersheds available in Iran is a costly, time consuming and difficult issue. Furthermore in the more watersheds of Iran there is no runoff measurement station and or the existing data are incomplete. Complete and reliable data in one of the important issues in design and researches related to hydrology. So usage of tools for the basic data preparation of water sources and soil protection in watershed management plans is a necessary and basic requirement. Runoff estimation with curve number is suggested by natural sources protection service of USA agricultural department and is famous to

NRCS and SCS method that between empirical methods of estimation of runoff height in more accurate and safe form has many application in the different climates of the world and in vast and global forms is used by hydrologists and designers of water sources and watershed projects. In this method preparation of curve number is the primary requirement that of data related to permeability and vegetation uses.

Many researches about the curve number methods has done up to now. But about this Sherman[2] was the first person who suggested the relation of precipitation and runoff in form of experimental and hydrograph format and following these studies soil protection service of America in 1954 presented a method to calculate the surplus precipitation which was called as curve number method. In this method at a shower always surplus precipitation and direct runoff is smaller or equal to total precipitation.[3]

Axundi 1380 used the curve number method in estimation of flood by geographical data system in northern Karun area. After the combination of the maps and maps' data the area curve number was calculated and with data related to floods (Debi and precipitation height) and with considering the runoff

height and maximum Debi of flood water was calculated. Final results showed that with increasing the calculation of area correlation coefficient between observational and estimated **Debi** will be decreased.[4]

Pandy and the associates (1999) with satellite images IRS-LB prepared the watershed use land map of remi then with the combination of use land maps, land cover and map of the soil of the area determined the hydrological soil groups and finally according to available data and standard table of curve number for India scale curve number of area according to area was determined. The results of this project showed that there aren't necessary circumstances for monitoring the runoff in the watershed of remiso to forecast the runoff we can use of SCS curve number method.[5]

Mohammadi and associates (1385) how the final result of estimation of transformation of precipitation to surplus precipitation named curve number with two different method, use of SCS scale method and use of observational data surveyed the Qaleh Chai Azarbaijan Sharghi area. In observational method 2 methods of use of interpolated precipitation layers and map of runoff height and overlapping layers and other with use of observational precipitation layers and Debi which for different flood water estimated came to notice.[6]

Akbarpur and Sharifi (1385) with Landsat satellite data ETM+ prepared land use map of Kameh that is in the northern part of Torbat Heydaryeh county in phase like method, two layers, and three layers and also maximum possibility method and compared the results.

Inclination map numeral height model and the abilities of the ERDAS and map of pastures condition with help of Tasseledcop index determined and pastures divided into three classes of average, poor and very poor. Finally by soil maps, inclination maps, geology formation, desert inspections hydrological soil group maps prepared and with SCS table and Arc View software curve number map of watershed runoff determined.[7]

Barati Qahfaroxi and associates (1388) with preparation of watershed curve number of Qaleh Shahrokh area with ETM+ satellite images in 2002 determined the use map of area with 6 classes. Then prepared hydrological soil group map and curve number map of area in ERDAS environment reached the land use maps. Based on the results of this research amount of estimated curve number for considered area at average moisture circumstances is equal to 87.24. Maximum curve number belongs to rocky areas, the ploughed pastures, dry farming

lands and minimum belongs to pastures with average vegetation.[8]

Yaqubzadeh and associates (1389) in his research prepared runoff curve number map with use of geographical data and Landsat satellite in 8 sub-area of Golestan province. Curve number map prepared with combination of vegetation land use and hydrological soil group and with SCS table and GIS software. Average weight of achieved curve number for each sub-area was indicator that in which sub-area volume of possible run off and flood-prone will be more. [9]

Yaqubzadeh and associates (1390) at their studies determined curve number map with the use of geographical data and image of Landsat satellite (ETM+) catchment area Mansur Abad of southern Khorasan and Navurud of Gilan based on the elements like hydrological soil group, land use and vegetation for assessment of the accuracy of the achieved curve number maximum Debi of flood water in both catchment areas with the help of HEC-HMS calculated and compared with observational amount. The results showed that the average weight of curve number of Mansur Abad runoff watershed area is more than Navurud watershed area which this matter can be the reason for outbreak of destructive floods

during the occurrence of abundant showers. [10]

The aim of this study is the preparation of Mohammad Abad curve number watershed area, in order to survey and runoff estimation in considered area that so land use map, hydrology soil group, vegetation of area and SCS table was used.

MATERIALS AND METHODS

Considered area:

Watershed Area of Mohammad Abad with the area about 16724 hectare in the southern part of Mazandaran province has been situated in limited area between $53^{\circ} 14' 30''$ and $53^{\circ} 20' 30''$ eastern length and $59' 30'' 35^{\circ}$ and $36^{\circ} 12' 30''$ northern width.

In figure 1 the location of considered watershed area in Iran and in province has shown. With topographic maps 1:25000 and according to the place of Ali Abad hydrometer station and based on considered aim area divided into 4 sub-areas. After making numeral the border of area and sub-areas the total area of considered area achieved 10.88 square kilometers.

The height difference between lowest and highest point of the area is 2201 that maximum height of sea level is 2847 and minimum height is 646 and the average height of total area is 1593.89 meters. Average inclination of area is 20 percent.

Average precipitation of area is 775.9 millimeter average yearly Debi is 14.6 cubic meter per second, average temperature is 15°C the warmest month of the year is Mordad (August) and the coldest month is Bahman (February). 543 permanent fountains and 7 seasonal fountains and 11 river flow in this area.

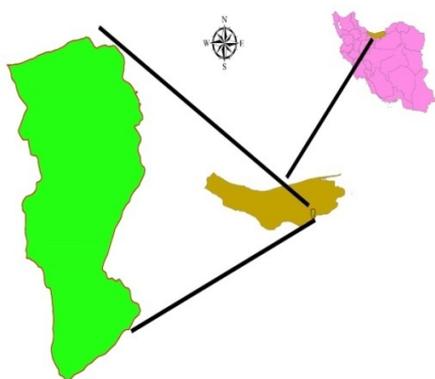


Fig.1 considered watershed situation

RESEARCH METHODOLOGY:

In order to prepare runoff curve number map of considered area data of OLI evaluator of Landsat 8 related to 2013 topographic maps 1:25000 numeral and papery of topography organization geology maps, SCS standard tables and other available numeral and printed data of area Arc GIS, Arc view, Erdas soft wares and etc have used. In this study total required data during the desert operations gathered and necessary maps with the use of above soft wares prepared and runoff curve number map was prepared during following stages.

Land use maps:

Land use is an important feature in runoff process which effects on penetration, erosion, evaporation and transpiration distributive hydrological models needs location data of land use area which vastly are determined by GIS and RS techniques.[11]

In order to prepare land use map Landsat satellite images was used. Before using satellite images first of all QUAC radio metric corrections have done then with arts of combination, combination operation was done on spectral bands. The picture which is achieved of Landsat satellite bands combination has the power of separation lower than 30 meters for this purpose with PAN band of satellite picture separability increased to 14 meters. Classification of the pictures is supervised and with the use of maximum possibility method was done.

According to locational and spectral separation power of OLI evaluator pictures and also date of pictures 6 classes of agriculture, jungle, barren lands, pastures, gardens, and residential lands are defined and sampling was in simple sampling method of the SCS. The samples were taken of areas which within a 30 meters radius a homogenous type of vegetation embraces the lands.

Finally in order to determine the separability ratio of the classes of Jefferies Mutusita

index was used. About this index whatever it is closer to two between 2 classes separability ratio of those classes is higher and if amount of this index is upper than 9.1 it shows very good separability and if it is upper than 7.1 it show rather good separability of the classes.

Table two show the separability of the classes proceeded after specifying the separability ratio of classes with respect to classification in supervised form and maximum possibility algorithm. For estimation of total and one by one accuracy of classes, statistic elements error matrix it means, producer accuracy, user accuracy, and assigned error and omitted error was used. Producer accuracy is called possibility that a pixel in classified image stand also on that class on the earth and user accuracy is called possibility that a specified class on the earth also stand on that class on the classified image.

Achieved results of different bands compound showed that band combination of MNFL,7,6 with Kappa coefficient and total correctness of 95 percent presents higher coefficients.

Hydrologic soil groups:

The role of soil features in emergence of runoff with hydrological elements is expressing that the minimum penetration

speed is at the lon0term moist condition of soil. Soils based on runoff creation potential according to division of America's soil protection organization (S.C.S) are divided into 4 groups A,B,C and D. In this available research of hydrological group maps for the considered area is prepared from natural sources bureau of Mzandaran province.

Runoff curve number map:

Recent decades development of hydrological models based on geographical data system came to notice of researcher and scientists in the world. one of the tools is SARA which in order to determine curve number, runoff height and volume based on NRCS has been presented. SARA required data layers to determine curve number includes index table, hydrological and user layers which this layers were prepared by following method.

Hydrological layers with performance of intersect operations prepared from two layers of land use and hydrological soil group layer in GIS environment. As a result of this act a map achieved with smaller units which every small units have a type of hydrological groups with specified user. Index table in excel environment is changeable and editable and can be changed according to location circumstances. In this table amount of curve number for every hydrological soil group according to the type of land use were

extracted based on available sources. Then this table's data were added in descriptive form.

RESULTS

Achieved results in present research includes determination of Kappa's coefficients, band's total correctness for combination of different bands, separation of ratio of determined land use classes. In considered area and amounts of statistic indexes in order to evaluation of accuracy and correctness of separated classes in desired methods have been presented at table 1 to 3. In figure 2 also land use map of the considered area, in figure 3 hydrological soil group and in figure 4 curve number map for the watershed area of considered area has shown.

Achieved results of combination of different bands showed that band's combination of MNFL,7,6 with 87.0 Kappa coefficient and overall correctness of 95 percent presents higher coefficients.

Table 3 shows land use area of area and map 1 shows lands use.

Table 4 shows the undercover area o hydrologic soil groups and map 2 shows the map of hydrological soil groups of the area.

Curve number map:

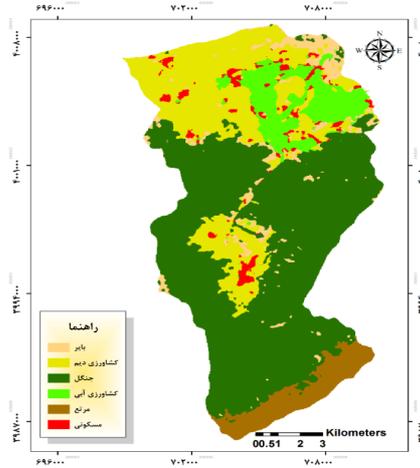
In Mohammad Abad aquifer area the least amount of curve number is 36and the most amount of curve number is 94and average weight of curve number is 66.

Table 1.achieved results of the combination of different band in present research

Total correctness (per cent)	Kappa's coefficient	Classification algorithm	Band combination
95	0.87	Maximum possibility	MNF ₁ , band 6, band 7
87	0.87		PCA ₁ ,band 2, band 3
93	0.82		◊MNF ₁ ,band 1 band 3
94	0.85		MNF ₁ ,PCA ₁ ,band 3
84	0.73		◊band 1,PCA ₁ band4
86	0.75		Band2◊ band3 band4

Table 2: Separability of classes in considered area

pastures	Residential lands	Dry farming	Water farming	User classes
1.99	1.99	1.96	-	agriculture
1.99	1.99	-	1.96	jungle
-	1.99	1.99	1.99	Barren lands
1.89	1.90	1.76	1.99	pastures
1.99	-	1.99	1.99	Residential lands



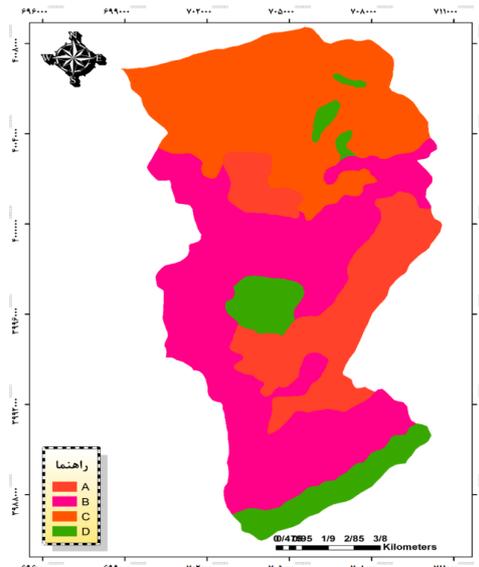
Map1. Land use maps of considered area

Table 3. area of different lands in considered watershed area

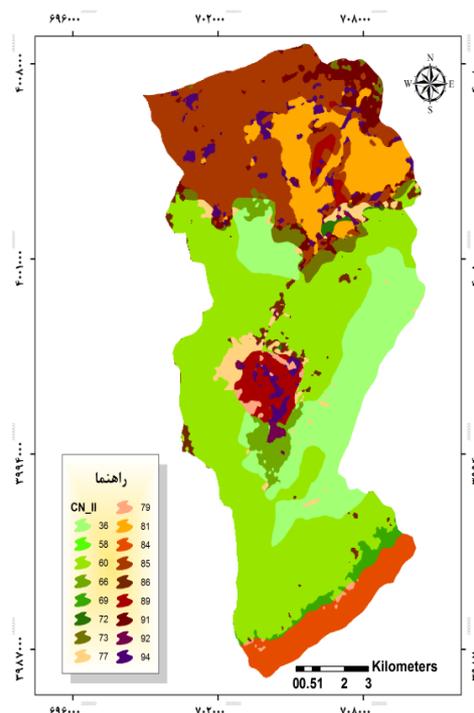
area	Lands use
3033	agriculture
2	barren
407	residential
9156	jungle
1406	garden
2729	pastures

Table 4. table of the areas of each hydrological groups in considered watershed area

area(hectare)	Hydrological soil groups
3066	A
6931	B
5131	C
1593	D



Map2. Hydrological soil groups of considered watershed area



Map3. Runoff curve number map of considered area

CONCLUSION

Geographical data system which has designed in order to produce recovery and display of the locational and non-locational data is considered as a tool to analyse parameters like land use, soil, topography and hydrological circumstances. Remote measurement technique with GIS is beneficial to gather, analyse, and interpret different data with high speed and less time in vast scales in order to aquifer planning. Thus the present research express of an approach that shows being sensitive to produce runoff in form of producing curve number map with use of RS and GIS techniques. Accuracy in estimation of curve number in used method in present research

has an important effect in hydrological calculations that made possible use of techniques. In present research RS technique is used in preparation of land use map and GIS is used in calculation of curve number with NRCS method for different groups of soil and was cleared that these tools can increase rapidity of action and accuracy of calculation. Based on accomplished research in considered area maximum curve number belongs to barren lands and residential area and minimum curve number belongs to jungles. According to this that hydrological groups of C and D groups had significant areas therefore fundamental actions should be done in order to prevent making runoff and flood during precipitation.

Results showed that amount of curve number for the most part of watershed area is high and circumstances for occurrences of flood water currents are ready but however researchers in this field looks indispensable.

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