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Extraction Drainage Network for Lesser Zab River Basin from DEM using Model Builder in GIS

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Abstract

ArcHydro is a model developed for building hydrologic information systems to synthesize geospatial and temporal water resources data that support hydrologic modeling and analysis. Raster-based digital elevation models (DEMs) play an important role in distributed hydrologic modeling supported by geographic information systems (GIS). Digital Elevation Model (DEM) data have been used to derive hydrological features, which serve as inputs to various models. Currently, elevation data are available from several major sources and at different spatial resolutions. Detailed delineation of drainage networks is the first step for many natural resource management studies. Compared with interpretation from aerial photographs or topographic maps, automation of drainage network extraction from DEMs is an efficient way and has received considerable attention. This study aims to extract drainage networks from Digital Elevation Model (DEM) for Lesser Zab River Basin. Composition parameters of the drainage network including the numbers of streams and the stream lengths are derived from the DEM beside the delineation of catchment areas in the basin. The results from this application can be used to create input files for many hydrologic models.

Keywords: DEM, GIS, Streams, Catchment, Model Builder

استخلاص الشبكة النهرية لحوض نهر الزاب الاسفل باستخدام موديل الأرتفاعات الرقمية ضمن نظم المعلومات الجغرافية

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الخلاصة

تم استخدام امتداد (ARC HYDRO) في برنامج (GIS) لتحديد الشبكة النهرية والأحواض الثانوية لحوض نهر الزاب الأسفل من خلال موديل الأرتفاعات الرقمي (DEM) والتي يمكن من خلالها ان تستخدم كملفات رقمية في الموديلات الهيدرولوجية .كما يمكن ان يشكل قاعدة بيانات جيدة للتعرف على الخصائص الشكلية للوديان التي قد تقود الى استنتاج العلاقة الكمية بين خصائص شكل الحوض وهيدرولوجية الوادي والذي يقارن عادة بالأشكال الهندسية المعروفة .كما تم تحديد مساحة كل حوض ثانوي واطوال الرتب النهرية اضافة الى ذلك تحديد بعض المعاملات المورفومترية للأحواض الثانوية و مدى اهميتها في مساعدة صاحب القرار في التعرف على نفاذية المياه الى داخل الأرض واحتوائه على الغطاء النباتي ، واهمية الكثافة التصريفية في الدلالة على سرعة الجريان السطحي للساقط المطري فيما انخفاضه يعني رشح المياه الى باطنها. لقد كان هناك انطباقا تاما بين الصورة القضائية والشبكة النهرية التي تم استخلاصها من خلال الموديل المستخدم في هذه الدراسة.

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Introduction:

Geographical Information System (GIS) is proving to be very valuable tools in many natural resources applications such as hydrologic modeling of terrain of water harvesting [1]. Model Builder is one of the most powerful tools in Arc GIS. The Model Builder environment introduces a new and exciting way to perform analysis and to automate workflows and watersheds. The Model Builder interface provides a graphical modeling framework to design and implement geoprocessing models reduces the user's time and energy besides providing a rich environment that closely integrates GIS and with tools available in Arc GIS and geographic data compatible to Arc GIS software .Model Builder process models. The features (which are extracted) are fundamental units for environmental modeling and management because they divide landscapes in a way that is relevant to the geomorphological and hydrological processes operating in an area. From the hydrological point of view, precipitation falling on either side of a watershed divide will follow different flow paths, with potential implications for water quality. Therefore, an understanding of the theoretical and technical aspects of stream network and watersheds extraction is important. Accurate delineation of drainage networks is a prerequisite for many natural resource management issues [2]. Drainage network is one of the main inputs for estimating rainfall runoff, predicting flood levels and managing water resources [3]. Automation of drainage networks extraction from Digital Elevation Model (DEM) has received considerable attention and the most commonly used approach is based on the deployment of a model for surface water flow accumulation. Arc Hydro beside a Model builder in GIS were used to delineate the Lesser Zab River Basin which is situated between latitudes 43° 21′ 41" – 46º 17′ 55" N and 35° 1′ 29" – 36º 54′ 41" E, the larger part of Lesser Zab River lies in the NE part of Iraq while the smaller part lies in Iran,. The total area of the basin is 19700.845 Km^2, 74.77% is located inside Iraq which represents 14729.690 Km^2 and 25.23 % is located inside Iran which represents 4970.310 Km^2. The Lesser Zab River Basin represents 6.49 % of 303339 Km^2 forming the Tigris river basin area Figure-1. Lesser Zab River represents one of the tributaries of Tigris River; it originates from Qandeel Mountain series. The river passes through groups of mountainous series, valleys, and plains; the mountainous region (high folded zone) includes the Qandeel series which extends along many series with less elevation and complexity like Permam Dagh, Safeen, Haibat Sultan, and Bazian (low folded zone) , plains and valleys are considered as separators between the mentioned series like Rania plain, Qoisenjaq,Alton Copri, and Daibaga valley[4]. Also the river passes through the low folded zone which extends between the high folded zone and Himreen mountain series, the important series which the river passes through it is Avana Dagh and its extension Kani Domlan, Qara Chuq , Khalkhal and Kanjero which lies between Kani Domlan an Butiawa. The river passes also through many of plains like Daibaga, Makhmoor, Erbil, Alton Copri and Haweeja. Due to highly structure and topographic complexity the river has different gradients starting from high gradient until passing Darband Gorge when the river begins to have low gradient. Some intermittent streams are joining in the lesser Zab through passing the low folded zone especially in Alton Copri , Daibaga , and Makhmour sub basins. The Lesser Zab joins the Tigris near the city of Sharqat north of Salah_Aldeen Governorate. From the above paragraph it is expected that the sturdy area will contain many catchments and it is difficult to delineate the catchments areas beside the streams from the topographic map.

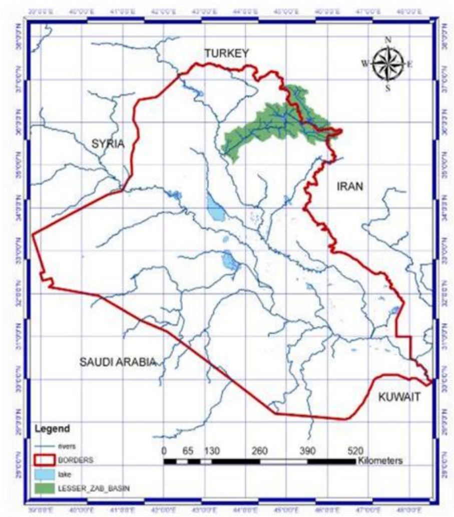

Figure 1- Location map of the studied basin

Objective of the Study:

The structure of stream network is complicated, so it is essential to reveal its features from the topographic maps. DEM is more useful to delineate the streams and their orders beside the delineation of the catchment areas in the Lesser Zab River Basin by using Model Builder in ArcGIS.

Method of Study:

The procedure used for watershed and stream lines delineation according to the ArcHydro software involves a sequence of steps accessed through the toolbar menus. The first of these is the reconditioning of the DEM data to reconcile with the stream layer; the system adjusts the surface elevation of the DEM to be consistent with vector coverage of a stream or ridge line coverage. Reconditioning is required to raise the base level of the DEM values to prevent negative values in the DEM because it would have created problems when filling sinks in the next step. Sinks are artificial features from DEM creation which are cells in which there is no adjacent downstream cell. Once sinks were filled, flow direction was calculated using the adjusted DEM values and steepest flow path algorithm and eight-direction pour path model. The next step was the calculation of flow accumulation, which was used when specifying the threshold by which streams are defined in the next step. The model designates stream path channels begin at the point at which the accumulation threshold was exceeded. The stream definition dialog sets the default threshold at ten percent of the total drainage area, which may be too detailed for small study areas or too general for large ones. However, processing large DEM files using small threshold values may require an extended processing period for completion. For this study, the threshold was set at five. The extraction of the drainage network of the study area carried out from an ASTER DEM, in raster format with a 30m*30m grid cell size .Hydrological tools in ArcGIS software, version 10 [4] was used to extract drainage channels. The automated method for delineating streams followed above mentioned series of steps. The main steps include sink filling, identification of flow direction, calculation of flow accumulation and stream definition .A model Builder was used to delineate the streams and the watersheds in the basin, a very comprehensive chart will show the entire process involved in the Watershed and streams Delineation.

Data used:

ASTER GDEM has uploaded the DEM of 30m*30m grid cell size which was cooperatively modified between Japanese Ministry of Economic and Trade from one side and NASA, this DEM was distributed starting from 29th of June 2009 and available in the National Center for Water Resources Management –Ministry of Water Resources. Figure-3 shows the DEM of Lesser Zab River Basin. From the DEM it was clear noticed that the high variation in the elevation (123-2550 m) asl in the basin, which certainly indicates to the availability of plenty of streams and hence water sheds.

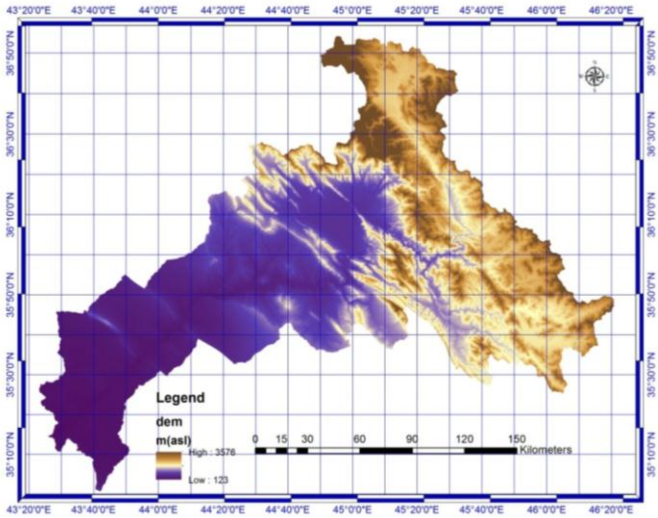

Figure 2- DEM of lesser zab river basin

Results and Discussion:

A new model was built to implement the steps of this work; Model Builder is how to create models and model tools. A model is a sequence of tools and data chained together; the output of one tool is fed to the input of another Figure-3.

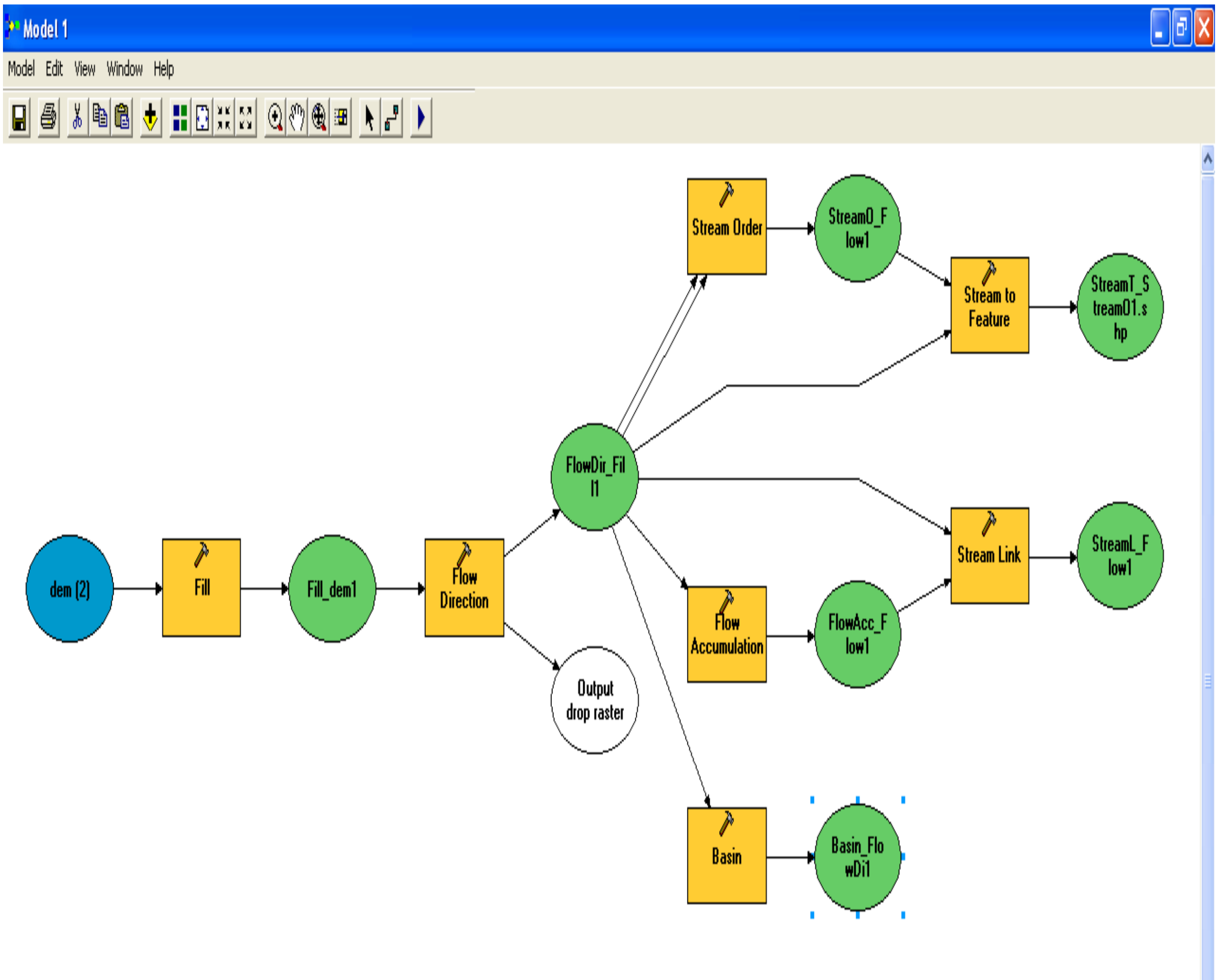

Figure 3- Model builder

When model is saved, it becomes a model tool (Arc GIS Help 10.1). A fill is the first step to delineate the stream orders and water sheds. This can occur when all neighboring cells are higher than the processing cell or when two cells flow into each other, creating a two-cell loop. The output of the sink tool is an integer raster with each sink being assigned a unique value. Sinks are numbered between one and the number of sinks. Then the flow direction map was created using "Flow Direction" function. In the flow direction map, the values of 1, 2, 4, 8, 16, 32, 64, and 128 represented eight possible direction of the flow in each cell. Based on the flow direction, the "Flow Accumulation" function was used. With the "Stream Definition" function, all the cells in the input flow accumulation grid that had a value greater than the given threshold grid was given a value of "1" and defined as stream grid. After linking the stream grid using the "Stream Segmentation" function, the Stream Link grid map was produced .Based on this map, drainage lines, i.e., stream network, were created using the "Drainage Line Processing" function, and catchments were created using the "Catchment Grid Delineation" and "Catchment Polygon Processing" function).The figure below Figure-4 shows the streams which are extracted after running the model.

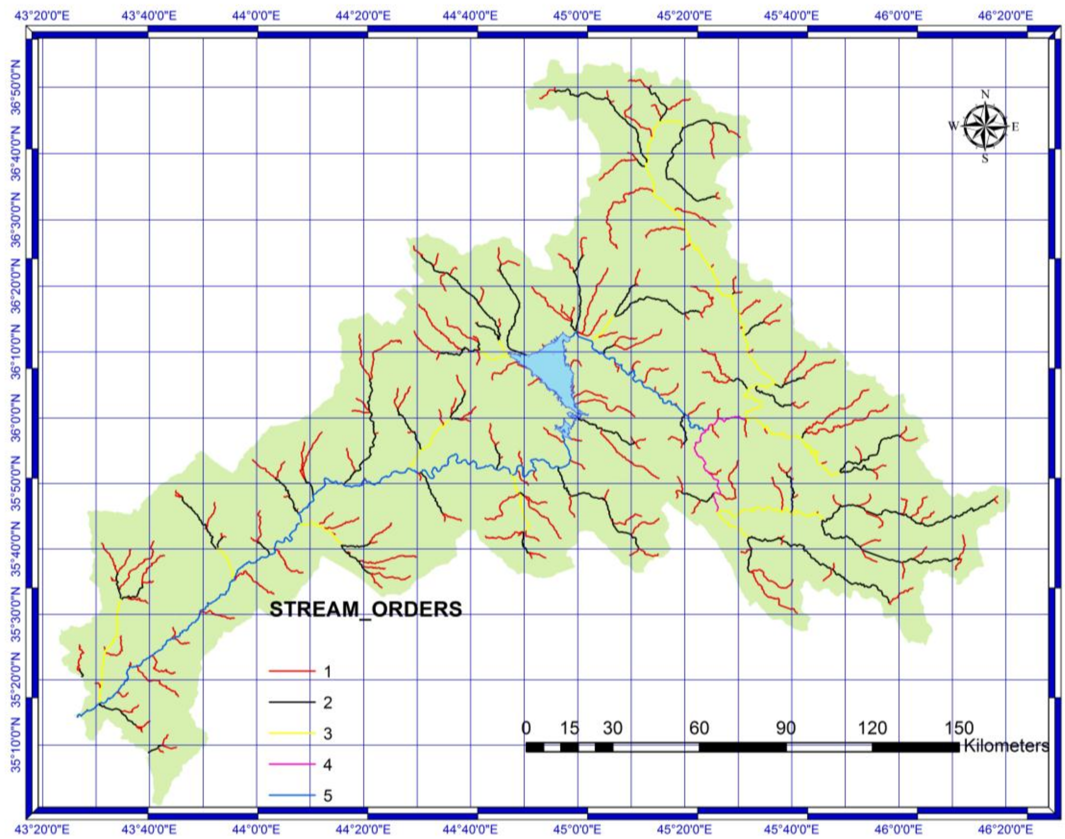

Figure 4 - Stream orders of the studied basin

Fifty five streams were extracted the shortest one has a length of 729.099 m, while the longest one of 79900.675 m. Table-1 contains the attributes of each stream ,marked the longest one .

Table 1- Attributes of the streams

Table

DrainageLine

OBJECTID *	Shape *	arcid	from_node	to_node	Shape_Length	HydroID *	GridID *	NextDownID *
9	Polyline	9	8	13	79900.675126	64	9	70
54	Polyline	54	51	55	65325.840055	109	51	110
24	Polyline	24	25	16	56542.102265	79	16	67
41	Polyline	41	39	43	48399.010185	96	40	99
34	Polyline	34	37	36	46943.339994	89	34	88
19	Polyline	19	14	23	44037.060023	74	17	76
31	Polyline	31	30	33	42784.821548	86	31	85
43	Polyline	43	32	45	39588.317489	98	33	101
28	Polyline	28	27	30	36031.274419	83	28	86
53	Polyline	53	54	55	34818.638001	108	54	110
29	Polyline	29	31	30	34738.819134	84	32	86
50	Polyline	50	48	51	34494.304449	105	49	109
30	Polyline	30	33	25	32876.46817	85	27	79
25	Polyline	25	26	24	31869.178093	80	26	81
13	Polyline	13	10	16	31598.755148	68	10	67
39	Polyline	39	42	35	31083.204331	94	39	90
22	Polyline	22	21	19	30911.35389	77	22	71
49	Polyline	49	50	51	27746.864136	104	50	109
15	Polyline	15	13	20	27625.34754	70	13	78
35	Polyline	35	35	39	26854.550013	90	37	96
44	Polyline	44	43	45	25136.046254	99	44	101
5	Polyline	5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

0 (1 out of 55 Selected)

DrainageLine

Stream Orders one of the most useful results extracting from DEM, The stream runoff nodes are collection of multiple geographical attribution of controlling watershed, in which hydrological attribution is the most important. The accumulation of each stream runoff node can used to record its daily flow rate; monthly flow rate and annual flow rate .Moreover; the stream runoff nodes reflect topographical, geological, vegetative and climatic features.

So the expressions of stream runoff nodes are flexible and diversified. According to the basic geomorphology the distribution of stream runoff node is highly correlated to geographical, geological and surface characteristics. The random distribution is the reflection of multiple factors of its controlling watershed. The morphological feature of stream runoff node distribution is obviously corresponding to their shape of hydrographical net. Temporal distribution characteristics include temporal attribution variation and temporal variation of different positions in the watershed. From temporal attribution variation, the stream runoff nodes can reveal the changes of daily flow rate, monthly flow rate and annual flow rate. Due to fluvial denudation, transporting action and deposition, river valley changes steadily, hence the position of stream runoff node varies correspondingly. So, temporal position variation of stream runoff node indicates the change and development of river valley, which has potentials to explore the hydrological view [6].

The next step is to distinguish the catchment areas (Watershed) a watershed is a geographical unit in which the hydrological cycle and its components can be analysed. The equation is applied in the form of water-balance equation to a geographical region, in order to establish the basic hydrologic characteristics of the region. Usually a watershed is defined as the area that appears, on the basis of topography, to contribute all the water that passes through a given cross section of a stream. The job is, that all sub-watersheds shall be obtained to all river sections Figure-5 shows the watersheds of the Lesser Zab River Basin, from the figure it appears that there are 55 watersheds in the Basin of the Lesser Zab River, all these watersheds could be merged to be less according to the aim of the study, each watershed includes one stream, while the areas of the watersheds vary.

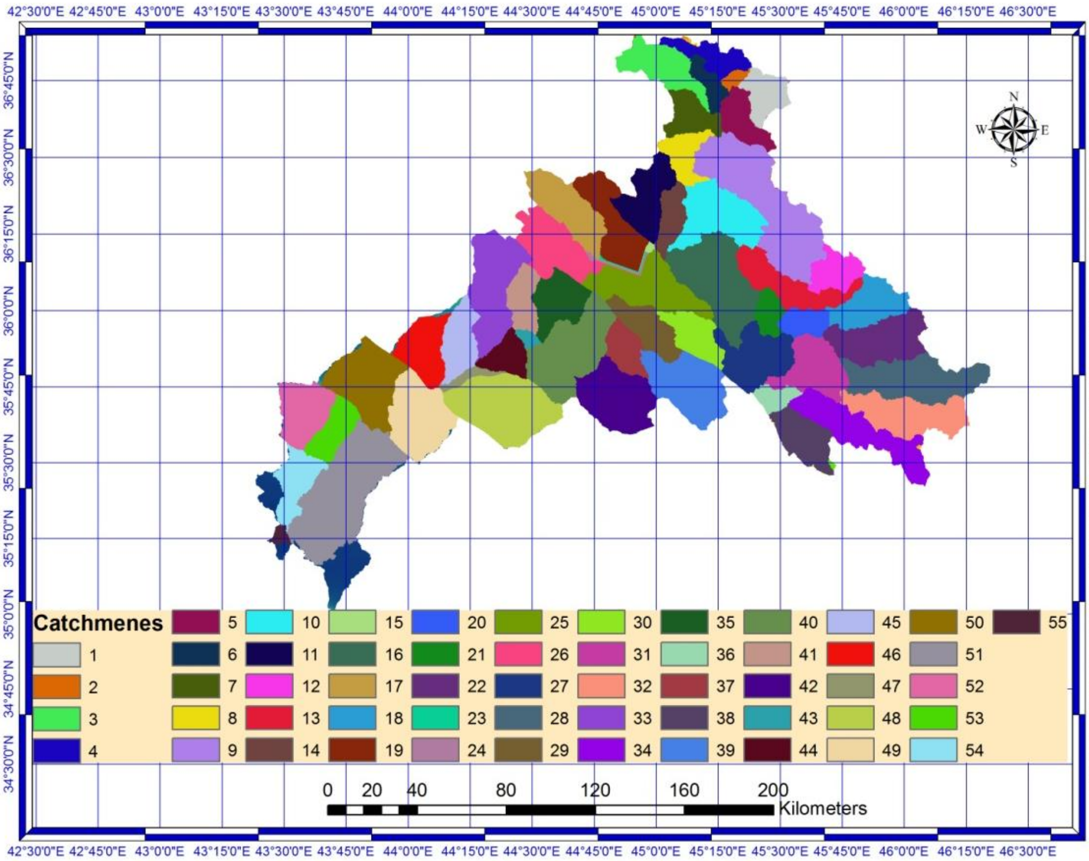

Figure 5- Extracted watersheds from DEM

From the Figure it's well-recognized that the smallest area of the 55 watersheds is 0,018912 Km² while the largest one of 1080,844173 Km² Table-2.

Table 2-The attributes of the watersheds

Table

polygones_1

OBJECTID *	Shape *	ID	GRIDCODE	Shape_Length	Shape_Area
60	Polygon	60	51	179415.633889	1080844173.7472
11	Polygon	11	9	197260.839277	1064109102.21448
52	Polygon	52	48	114880.324673	757270597.062591
28	Polygon	28	16	136868.824291	731539775.67266
47	Polygon	47	40	129725.734628	699616938.134923
30	Polygon	30	28	154469.833004	641567499.804011
45	Polygon	45	33	136409.276001	616599782.371814
54	Polygon	54	50	115371.901549	577248868.370379
44	Polygon	44	39	109848.033117	562467080.889146
41	Polygon	41	34	163334.360671	553149722.276611
55	Polygon	55	49	101745.775834	549667190.657183
48	Polygon	48	42	102188.029064	546031561.827479
27	Polygon	27	25	134488.385022	529779221.531546
14	Polygon	14	10	130345.48994	521976180.203394

The extracted stream lines were compared with the Satelite image, Figure-6 shows the matching of the extracted stream lines with the Satelite image which were completely match.

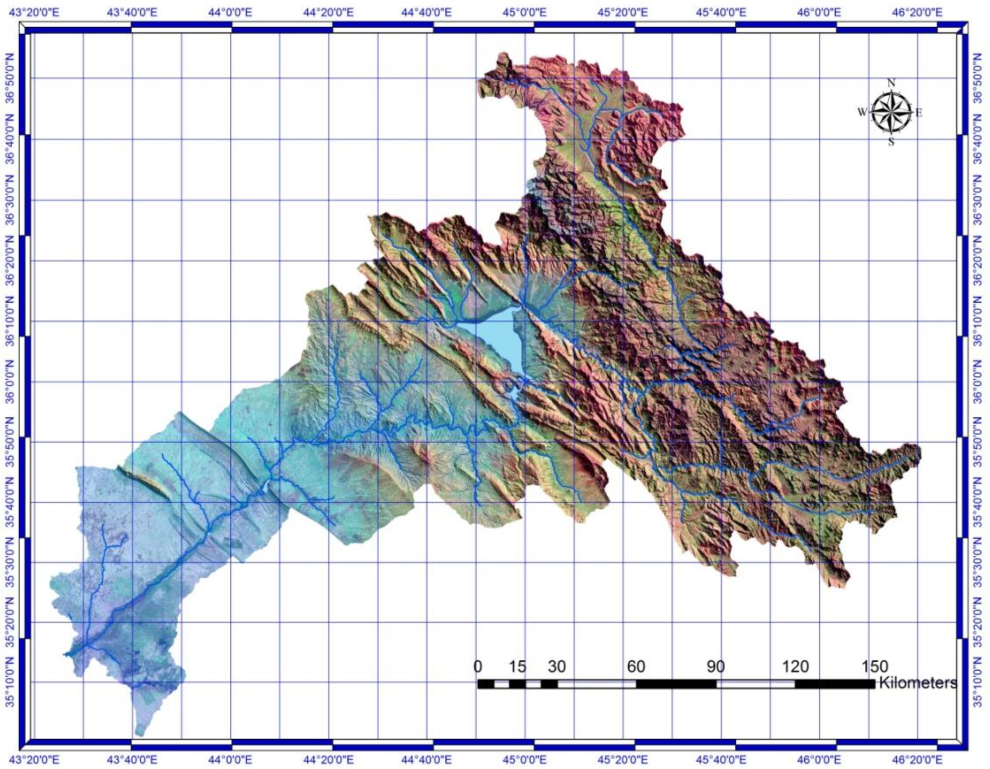

Figure 6- Matching of extracted streams with satellite image.

Drainage Basin Morphometry:

Quantitative morphometric analysis of watershed can provide information about the hydrological nature of the rocks exposed within the watershed. A drainage map of basin provides a reliable index of permeability of rocks and their relationship between rock type, structures and their hydrological status. Watershed characterization and management requires detail information for topography, drainage network, water divide, channel length, geomorphologic and geological setup of the area for proper watershed management and implementation plan for water conservation measures [7].Morphometric analysis is pointed to the quantitative evaluation of characteristics of the earth surface and any landform unit. This is the most common technique in basin analysis, as morphometry form an ideal areal unit for interpretation and analysis of fluvially originated landforms where they exhibits and example of open systems of operation. The composition of the stream system of a drainage basin in expressed quantitatively with stream order, drainage density, bifurcation ration and stream length ratio [8]. It incorporates quantitative study of the various components such as, stream segments, basin length, basin parameters, basin area, altitude, volume, slope, profiles of the land which indicates the nature of development of the basin. The basin geomorphic characteristics have long been believed to be important indices of surface processes. These parameters have been used in various studies of geomorphology and surface-water hydrology, such as flood characteristics, sediment yield, and evolution of basin morphology. The detailed analysis of morphometric and morphological character indicate the role of the neotectonics in shaping the drainage basin [9]. As the main objectives of this work was to discover stream properties from the measurement of various stream attributes.

Drainage Density (Dd):

Horton [10] has introduced drainage density as an expression to indicate the closeness of spacing of channels. It is a measure of the total length of the stream segment of all orders per unit area and controlled by the Slope gradient and relative relief of the basin. The total length of the streams is 1203.201 Km as shown in the figure-7.

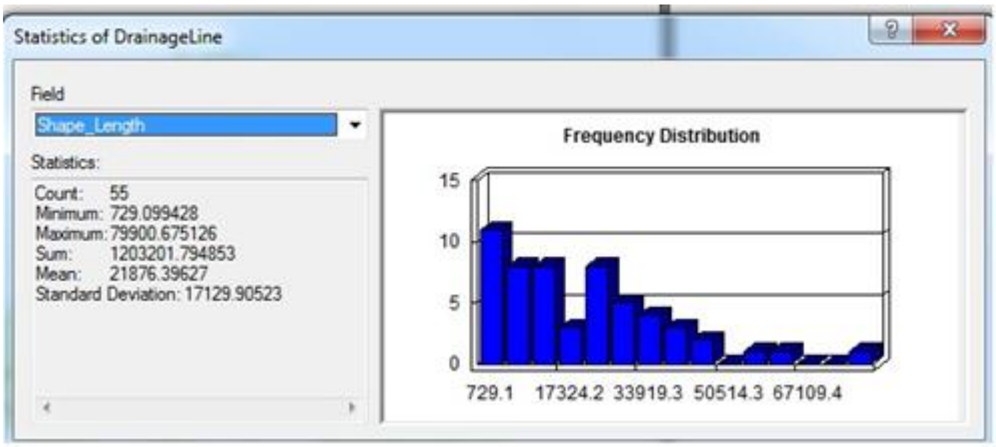

Figure 7- Statistics of length streams.

While the statistics of shape area as mentioned and shown in figure-8 is 19760 Km^2.

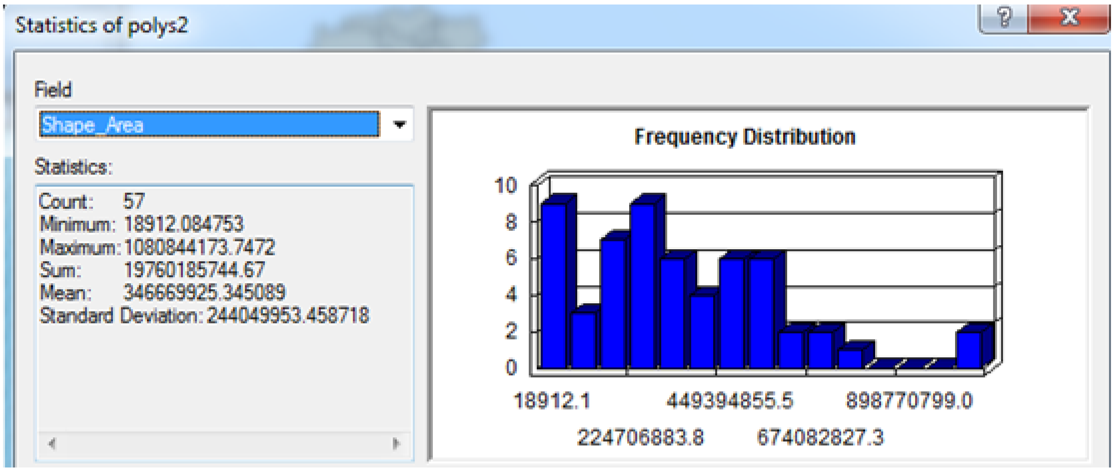

Figure 8- Statistics of shape area

This means that the drainage density is equal to 0.259 Km^{-1}. Smith [12] has classified drainage density into five different textures. The Drainage density less than 2 indicates very coarse, between 2 and 4 is related to coarse, between 4 and 6 is moderate, between 6 and 8 is fine and greater than 8 is very fine drainage texture. It is observed that, if the drainage texture is large it indicates the presence of highly resistant permeable material with low relief. The variation in the value of drainage texture (T) depends upon a number of natural factors such as climate, rainfall, vegetation, rock, soil type and their infiltration capacity and relief of the basin. High drainage density is the resultant of weak or impermeable sub surface material, thin vegetation and mountainous relief. The low drainage density of the Lesser Zab River Basin reveals that they are composed of permeable subsurface material, good vegetation cover, and low relief which results in more infiltration capacity in the watershed. Drainage basin with high Dd indicates that a large proportion of the precipitation runs off. On the other hand, a low drainage density indicates the most rainfall infiltrates the ground and few channels are required to carry the runoff. The drainage density is found to increase from the lower part of the basin to the upper part Figure-9.The factors affecting drainage density include geology and density of vegetation. The vegetation density influenced drainage density by binding the surface layer and slows down the rate of overland flow, and stores some of the water for short periods of time. Permeable rocks with a high infiltration rate reduce overland flow, and consequently drainage density is low.

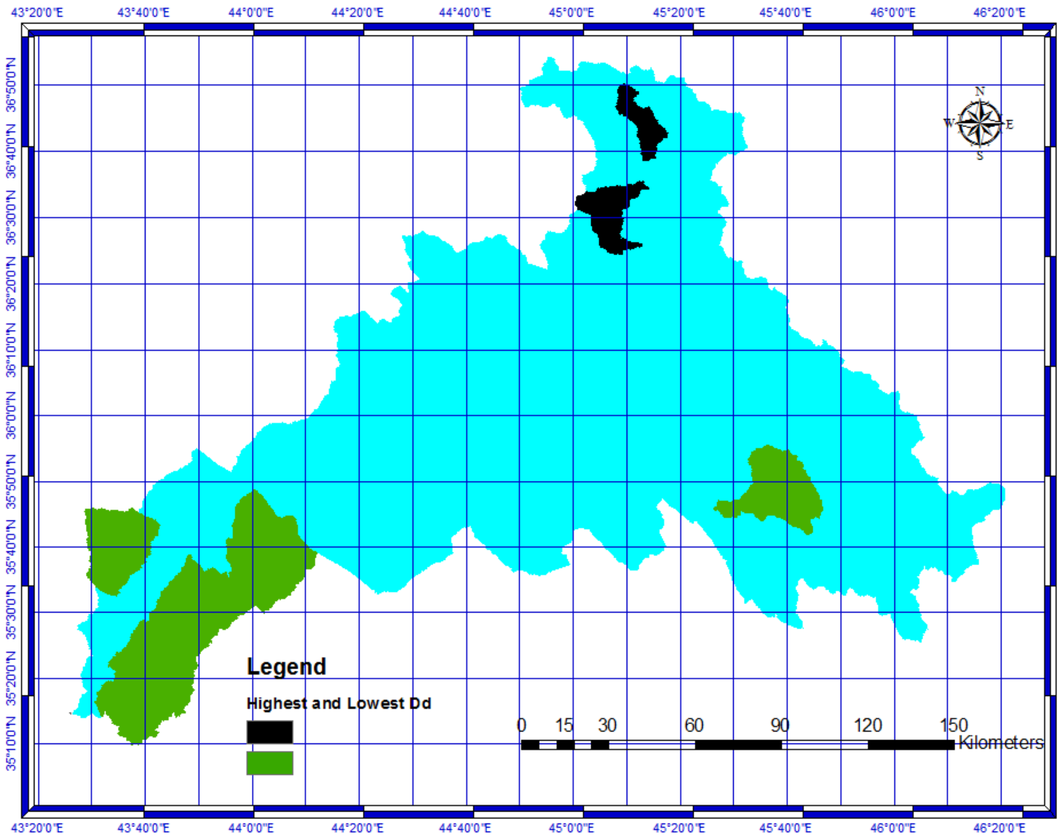

Figure 9- The drainage density

Basin shape

The shape of the basin mainly governs the rate at which the water is supplied to the main channel. The main indices used to analyze basin shape are the elongation and relief ratios. The elongation ratio is calculated by dividing the diameter of a circle of the same area as the drainage basin by the maximum length of the basin, measured from its outlet to its boundary. Three parameters {Elongation Ratio (Re), Circulatory Ratio (Rc) and Form Factor (Rf)} are used for characterizing drainage basin shape, which is an important parameter from hydrological point of view.

Elongation Ratio (Re):

Elongation ratio (Re) is the ratio between the diameter of the circle of the same area as the drainage basin and the maximum length of the basin [11]. Values close to 1.0 are typical of regions of very low relief, whereas values in the range 0.6–0.8 are usually associated with high relief and steep ground slope [13]. These values can be grouped into three categories namely (a) circular (>0.9), (b) oval (0.9–0.8), (c) elongated (<0.7). The elongation ratio of the Lesser Zab River Basin is 0.22, which indicates that the basin belongs to the elongated shape basin and low relief. Schumm's 1956[11] used an elongation ratio (Re) defined as the ratio of diameter of a circle of the same area as the basin to the maximum basin length. The value of Re varies from 0 (in highly elongated shape) to unity i.e. 1.0 (in the circular shape).Thus higher the value of elongation ratio more circular shape of the basin and vice-versa.

Circularity Ratio (Rc):

Miller [14], defined dimensionless circularity ratio (Rc) as ratio of basin area to the area of circle having the same perimeter as the basin. Rc is influenced by the length and frequency of streams, geological structures, land use/land cover, climate, relief and slope of the basin. A circularity ratio of the basin is 1.31 which indicates strongly elongated and highly permeable homogenous geologic materials. The observed circularity ratio of the basin indicates that the basin is elongated in shape, has low discharge of runoff and highly permeable subsoil conditions. The circularity ratio is a similar measure as elongation ratio, originally defined by [13], as the ratio of the area of the basin to the area of the circle having same circumference as the basin perimeter. The Circulatory ratio for all basins is in the range of 0.108 to 25.71. Higher the value represents more circularity in the shape of the basin and vice-versa. Naturally all basins have a tendency to become elongated to get the mature stage.

Form factor (Ff):

According to Horton [10], form factor (Ff) may be defined as the ratio of the basin area to square of the basin length. The form factor indicates the flow intensity of a basin for a defined area. The form factor value equals to 0.039. The smaller the value of the form factor, the more elongated will be the basin. Basins with high-form factors experience larger peak flows of shorter duration, whereas elongated basin with low-form factors experience lower peak flows of longer duration. The observed form factor value of the basin is 0.039 suggesting that the shape of the basin is elongated. The elongated basin with low form factor indicates that the basin will have a flatter peak of flow for longer duration.Table-3 shows the morphometric parameters of the watersheds in the basin.

Table 3- The morphometric parameters of the watersheds in the basin.

ID	GRIDCODE	Length(Km)	Area(sqKm)	Dd	Re	Rc	Ff
29	28	0.644	0.019	34.074	0.241	25.771	0.046
8	7	0.687	0.030	23.276	0.282	20.623	0.062
5	3	1.031	0.059	17.457	0.266	14.582	0.056
59	55	27.783	35.401	0.785	0.242	0.596	0.046
42	43	28.587	38.967	0.734	0.246	0.568	0.048
2	2	32.589	43.201	0.754	0.228	0.539	0.041
50	47	59.720	66.179	0.902	0.154	0.436	0.019
37	36	51.124	113.580	0.450	0.235	0.333	0.043
6	6	64.520	131.760	0.490	0.201	0.309	0.032
25	21	54.249	141.932	0.382	0.248	0.297	0.048
23	20	56.131	159.653	0.352	0.254	0.280	0.051
46	44	64.061	189.866	0.337	0.243	0.257	0.046
15	14	71.919	195.814	0.367	0.220	0.253	0.038
40	37	65.245	203.047	0.321	0.246	0.249	0.048
1	4	96.092	206.547	0.465	0.169	0.247	0.022
10	8	83.359	208.777	0.399	0.196	0.245	0.030
38	41	70.717	216.357	0.327	0.235	0.241	0.043
12	12	76.952	226.647	0.340	0.221	0.235	0.038
3	1	72.392	228.719	0.317	0.236	0.234	0.044
9	7	78.003	229.164	0.340	0.219	0.234	0.038
7	5	77.868	231.646	0.336	0.221	0.233	0.038
57	53	75.776	240.117	0.316	0.231	0.229	0.042
31	30	84.675	265.747	0.319	0.217	0.217	0.037
58	54	100.900	286.967	0.352	0.189	0.209	0.028
35	29	87.983	293.621	0.300	0.220	0.207	0.038
49	45	87.381	294.703	0.297	0.222	0.206	0.039
43	38	85.887	325.035	0.264	0.237	0.197	0.044
39	35	87.047	328.536	0.265	0.235	0.196	0.043

51	46	84.735	342.392	0.247	0.246	0.192	0.048
16	18	95.653	345.620	0.277	0.219	0.191	0.038
4	3	111.380	357.342	0.312	0.192	0.187	0.029
56	52	84.820	370.056	0.229	0.256	0.184	0.051
13	11	102.786	377.333	0.272	0.213	0.182	0.036
32	31	103.821	401.491	0.259	0.218	0.177	0.037
17	13	141.229	402.580	0.351	0.160	0.177	0.020
21	17	102.534	426.965	0.240	0.227	0.172	0.041
36	27	116.161	460.688	0.252	0.209	0.165	0.034
18	19	130.958	463.448	0.283	0.186	0.165	0.027
26	26	142.472	464.615	0.307	0.171	0.164	0.023
24	22	116.901	499.846	0.234	0.216	0.159	0.037
33	32	138.395	509.806	0.271	0.184	0.157	0.027
14	10	130.345	521.976	0.250	0.198	0.155	0.031
27	25	134.488	529.779	0.254	0.193	0.154	0.029
48	42	102.188	546.032	0.187	0.258	0.152	0.052
55	49	101.746	549.667	0.185	0.260	0.151	0.053
41	34	163.334	553.150	0.295	0.163	0.151	0.021
44	39	109.848	562.467	0.195	0.244	0.149	0.047
54	50	115.372	577.249	0.200	0.235	0.148	0.043
45	33	136.409	616.600	0.221	0.205	0.143	0.033
30	28	154.470	641.567	0.241	0.185	0.140	0.027
47	40	129.726	699.617	0.185	0.230	0.134	0.042
28	16	136.869	731.540	0.187	0.223	0.131	0.039
52	48	114.880	757.271	0.152	0.270	0.129	0.057
11	9	197.261	1064.109	0.185	0.187	0.109	0.027
60	51	179.416	1080.844	0.166	0.207	0.108	0.034
	Average		**19756.138**	**1.668**	**0.220**	**1.317**	**0.039**

Conclusion

Stream network has its importance in geography and hydrology. So as the collection of confluence of one stream and it is corresponding tributaries in the drainage, the stream network has great significance in geology and hydrology and has plenty information, with GIS, it can be extracted easily and efficiently. The category of the stream network provides more view to study its features and reveal relationship with other spatial features. Extracting channel networks, delineating sub-watersheds and measuring geomorphometric parameters from topo-maps require time; in contrast, an automated delineation using Model Builder in GIS is more sophisticated, convenient, and can be circumvented the efforts on digitizing to incorporate with other GIS data. It extracts the highest resolution channel network statistically consistent with geomorphology. However, the results could be further applied to many other watershed characteristics extraction and watershed delineation applications, and provide decision support for water resources management in various regions. The extracted stream network was completely matched the Satellite Image. The morphometry of the whole basin has low drainage density reflects that it is composed of permeable subsurface material, good vegetation cover, and low relief which results in more infiltration capacity in the watershed. Some of the watersheds with high drainage density especially in the upper part of the basin indicate that a large proportion of the precipitation runs off. On the other hand, a low drainage density in the lower parts of the basin indicates the most rainfall infiltrates the ground and few channels are required to carry the runoff. The parameters which are used for characterizing drainage basin shape indicate that the basin belongs to the elongated shape basin and low relief.

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