Designing A Rainstorm Over AL-Zafran Valley Basin and Modelling Surface Runoff Using Modern Geographic Techniques

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Abstract. Initially, the research includes building a geographic information base for the basin. Moreover, the DEM satellite imagery was used to map the drainage network in AL-Zafran Valley, and these maps were entered into Arc GIS 10.7. A map of the river basin and the water network was produced, classified according to the method of introduction and application of valley analysis within Arc GIS and mapping software. Digital elevations and contour lines of the study area. Digital maps were produced and various linear measurements were taken and some spatial relationships were made between the various features of the basin. The natural characteristics that affect the basin were also studied, especially the rocky nature, climatic and topographical characteristics. The total area of the basin was (612.4 km²), and a topographic model was drawn that reflects its topographical characteristics and the extent of its impact on the characteristics of the river network. Therefore, the adoption of new technologies played a role in knowledge. The precise details of the study area without resorting to the field study as rainstorms (modeling) after designing a rainstorm, and its intensity varies and shows the correlation of flood waves, modeling and simulation with realistic data with the intensity of rain. This was done using recent software, including the 10.1W (watershed) watershed model program, the WMS10.1 program (HYDROCAD (HEC-HMS)) to find rainfall intensity and its relationship to surface runoff in AL-Zafran Valley Basin, and the Surfer 13 program and system. Geographic Information - ARC10. Scene 7 and QGIS 3.8 geo-modelling program.

1. Introduction
The study of hydro climate is of great importance in the studies of physical geography. This is due to the importance of these studies in the field of extreme phenomena of floods and droughts.

Therefore, the modeling of hydrological processes in the atmosphere and the Earth's surface as a coupled system in the study area needs atmospheric inputs to the terrestrial hydrological component, such as precipitation, radiation and relative humidity, as opposed to the need for meteorological information such as an external input for an independent hydrological component model (snow melting, spring water and subterranean). This creates a very significant advantage in solving these lingering problems in complex, disconnected and disconnected valley basins and when double hydrological modeling is performed over the basin, the unknown sedimentation and other atmospheric inputs of the hydrological component are resolved as part of the conjugation system, providing important information for the solution
of the unconnected basins hydrology... Likewise, linking oceanic processes to hydrological or atmospheric processes may also convey some important information, such as sea surface temperatures, for effective long-term prediction of hydrological processes in watersheds that may be very far from the ocean, and which may be the primary source of moisture supply. To the watershed. Beginning in the late 1980s and early 1990s, hydrological engineers recognized the value of double-reactive modeling of hydrological processes along with atmospheric or oceanic processes, and began to develop physical-based regional models alongside hydrological atmospheric models. These are called climate models.

Accordingly, various statistical tools have been used in an attempt to correlate different indicators of oceanic processes with hydrological variables to improve hydrological prediction. To achieve different statistical approaches towards modeling different hydrological and climatic processes on large watersheds and regions to predict long-term hydrological processes, water resources planning, and assess the impact of climate change on the hydrological system in the region.

Therefore, it became necessary to return to the aim of the research, which focused on two directions:
first: estimating the volumes of torrents and their peak flow in the valleys' streams because of the intensity of rain in the study area for determining the degree of severity of the torrents in relation to the basins.
the second: designing a rainstorm that simulates the entire reality of AL-Zafran Valley Basin, while the research problem is the following question:
what is the intensity of the rains that cause the flood waves within 24 hours, and then estimate the size of the torrents that sweep the valley according to the research hypothesis; the rainstorms had a clear effect on changing the water drainage properties in the valleys of the study area.
which indicates the existence of a quantitative and qualitative link, the quantitative embodiment in the economic fields, specifically the storage of liquidity, in terms of quality; embodied in the exchange of economic experiences. The importance of studying Saffron Valley stems from the fact that the river networks in it are important water sources for the population and for development projects represented in building small dams and water collection barriers for agricultural purposes or to reduce the risk of floods. In the rainy season, many activities and human activities are concentrated in the river basin and its drainage areas.
The course of the valley is also affected by many external factors such as the amount of rain and the characteristics of the valley basin, such as the nature of the rocks, the course of the valley and its formation, the amount of load and the flow velocity. Terrain is also an important factor affecting wadi drainage in terms of increasing or decreasing the flow of water in time and place all the time. The path of seasonal torrents.

2. Aim of work
This study aims to use modern technology, including geographic information systems technology, to reveal the formal characteristics of AL-Zafran Valley basin, represented by the spatial, longitudinal, morphological and topographical characteristics, and the characteristics of the drainage network.

3. AL-Zafran Valley
valley Zafran slopes in the direction of the northeast and southwest, and its shape is characterized by the presence of concavity in its upper parts, and it is famous for its steep slope, and the more straight its direction is towards the course of the river, its height is between 1612-6 m. ( Al-Hamiri, 2011, pp. 271-284) (1) AL-Zafran Valley Basin is located in the northeastern part of Maysan Governorate, between longitudes (46.22-46 42) east and two circles of latitude (32.33 32.57) north extended. Within the borders of Iranian territory, the valley Basin is divided into secondary basins, including the Khuzina Valley. (Gary, 2011, p. 331.) (2) Illiteracy, to
know the intensity of the degree of shade, (Al-Mousawi 2016, p. 108) (3) to know the areas that face the sun's rays, to determine the best areas for building and installing solar cells, to know the density of vegetation, and to stimulate tourism. It is distributed between (0-254), and the study area is divided according to degrees of shade intensity into (severe, medium, light shade).

The slope is divided between (north (1), northeast (2), east (3), southeast (4), south (5), southwest (6), west (7), northwest (8), this Between (1-123), while the height of the study area was determined between (6-1612) m. See Map No. (1).

Map 1. the degree of shadow intensity, direction of slope, ratio of slope, and height of the study area

*Map is taken from a researcher's work, based on DEM and ARC MAP 10.7.

4. **Sources feeding the valley Zafran Basin**

The valley of AL-Zafran basin depends on melting snow and rainwater to feed the valley and the course of the valley dries up seasonally according to the frequency and amount of rain during the rainy months. Most of its water sources are concentrated from the Noble Mountains, which are located within Iranian lands at an altitude of 450 meters, and the course of the Saffron...
River is part of the river part of the river Roh Khanh, which crosses the Noble Mountains through the Bint Valley and the Tunnel Mountains, are the twisted mountains that were formed during the Alpine movement (Gary, (2012), p. 333) (4).

5. Designing different rainfall intensities and their impact on the response of AL-Zafran Valley Basin using modern digital programs (WMS10.1, HYDROCAD (HEC-HMS)).

The area of valley AL-Zafran is 612 km2, and it fell on the valley basin with an intensity of rain amounting to 183 mm 3 in the month of April on 12/4/2018, within one day the amount of rain is distributed at different depths between the western Ali station 31 mm 3, Ilam station 87 mm 3 and the station Dahlran 65 mm 3, based on the storm depth data, rainfall in stations of the study area for a period of 24 hours (1440 minutes), while the totalitarian conditions caused sudden waves of floods caused by the advancement of the Mediterranean depression, in addition to a shallow depression centered in the Gulf.

Al Arabic at the level of 1000 mill bars coinciding with an upper depression (the polar groove that feeds it with a cooling factor to keep the condensation process at the level of 500 mill bars, which led to the occurrence of varying intensity of rain in the depth of the rainstorm over the entire basin of the Saffron Valley, while the table (1) shows a storm Rain occurred for a period of 24 hours, the intensity was as follows, at 12 noon April 12, 2018, a rainstorm with heavy precipitation of (78) mm 3 depth, while the loss was (53) mm 3 between evaporation, infiltration and absorption, to overflow from rain (24.9) mm 3, and the reason for this is a borderline D. A sudden wave of floods and torrents b. After heavy rains fell at one o'clock in the evening, amounting to (2318) m3 / s, the intensity of the rainfall lasted 6 hours, and its depths ranged between (78) - (6) mm 3 in relation to the total value of the loss between (leakage, Evaporation, absorption) due to the dry area conditions and high soil seepage in the study area.

The spread of dense seasonal vegetation also contributed to the increase in the absorption rate, reaching about (123.6) m3, while the amount of surplus reached (59) m3 during a whole day according to the HEC program. See figure (1) is from the researcher's work based on the HMS program and the table (1) (HEC-HMS program) Seen map (2), (3).

Figure 1. design of a rainstorm and a flood summit, a realistic simulation of AL-Zafran Valley.
Map 2. the impact of the study area by a Mediterranean depression within the level of 1000 mill bars on 12/4/2018. Source: (5).

Map 3. An extension of an upper polar groove towards the study area within the pressure level of 500 mill bars on 12/4/2018. Observation (00) GMT.
Table 1. the depths of the rainstorm in the Saffron Valley and the occurrence of the peak of the flood wave with an indication of (surplus + loss) for a period of 24 hours, Source: (6).

| Time (00:00) | Rainfall (MM) | Loss (MM) | Total (MM) | Surplus (MM) |
|--------------|---------------|-----------|------------|--------------|
| 12 Apr 2018  | 0.01          | 1.91      | 2.92       | 0.00         |
|              | 0.03          | 2.07      | 2.10       | 0.00         |
|              | 0.06          | 2.23      | 2.29       | 0.00         |
|              | 0.10          | 2.38      | 2.48       | 0.00         |
|              | 0.14          | 2.60      | 2.74       | 0.00         |
|              | 0.20          | 2.91      | 3.11       | 0.00         |
|              | 0.28          | 3.07      | 3.35       | 0.00         |
|              | 0.37          | 3.47      | 3.84       | 0.00         |
|              | 0.58          | 4.36      | 4.94       | 0.00         |
|              | 0.80          | 5.35      | 6.15       | 0.00         |
|              | 1.71          | 8.17      | 9.88       | 0.00         |
|              | 24.94         | 53.38     | 78.32      | 12 Apr 2018  |
|              | 8.91          | 11.04     | 19.95      | 12 Apr 2018  |
|              | 4.19          | 4.60      | 8.79       | 14 Apr 2018  |
|              | 3.01          | 3.12      | 6.13       | 15 Apr 2018  |
|              | 2.43          | 2.42      | 4.85       | 16 Apr 2018  |
|              | 2.03          | 1.98      | 3.99       | 17 Apr 2018  |
|              | 1.81          | 1.70      | 3.51       | 18 Apr 2018  |
|              | 1.60          | 1.46      | 3.06       | 19 Apr 2018  |
|              | 1.36          | 1.24      | 2.60       | 20 Apr 2018  |
|              | 1.20          | 1.09      | 2.29       | 21 Apr 2018  |
|              | 1.20          | 1.05      | 2.25       | 22 Apr 2018  |
|              | 1.15          | 0.99      | 2.14       | 23 Apr 2018  |
|              | 1.12          | 0.98      | 2.09       | 24 Apr 2018  |
|              | 0.94          | 0.00      | 0.94       | 01 Apr 2018  |
|              | 0.26          | 0.00      | 0.26       | 02 Apr 2018  |
|              | 0.72          | 0.00      | 0.72       | 03 Apr 2018  |
|              | 1.90          | 0.00      | 1.90       | 04 Apr 2018  |
|              | 0.40          | 0.00      | 0.40       | 05 Apr 2018  |

It is noticed from the table (1) and figure (1) that it is at 12 noon, April 12, 2018, a severe rainy storm occurred, which lasted for several hours and at various depths. The amount of loss during peak times reached (11) mm 3 between evaporation, leakage, absorption and flooding from rain by (8.9) mm 3, which caused a sudden wave of floods and flash floods that reached a peak of about (2318) m3 / s, the intensity of the rainstorm that continued For a period of 10 hours at depths ranging between (110) - (5) mm 3 after rain, the depths of which are distributed among the dominant stations, the intensity of rainfall in the valley basin is characterized by being intermittent, causing the saturation of the ground, and from there a sudden flow of torrents in the course of the Wadi Basin Saffron, then a gradual withdrawal of the flow.

6. Calculation of the volume of runoff in AL-Zafran Valley according to the data of the study area stations by means of a 10.1 GIS ARCMAP program from the watershed model (watersheds)

During the rainy seasons, (intensity of precipitation) fell on the valley basin at different depths, the maximum was at 173 mm 3 in one day (1440 minutes), the maximum precipitation was in April 12/2018 (630 mm) 3 while the total depth rates reached The yearly period between 1996-2018 is about (865) mm 3 distributed between the stations Al Gharbia, Ilam and Dhahlran with a depth of (274,413,178) respectively, and in light of this, the predictive estimate was calculated.

Over a period of 100 years according to the WMS hydrograph, the peak drainage of the valley was 3 cm and reached 2256 cm. 3, while the volume of surface runoff reached 353 million m3, while the soil is classified according to the analysis of soil samples to (ADC), which means that the soil category helps in the occurrence of low runoff in a particular area and is particularly high. Above average in other regions, Class (A) consists of a deep sandy layer, clay and silt, while Class (D) consists of a thick clay layer and shallow soil spread over a bare rock layer, and it consists of (C) of a clay layer of a certain depth, while The value of (SCS-40 CN = 37,693), thus it has medium permeability surfaces, the slope ratio is 4.613%, TC = 61,
equivalent to two days of concentration (the arrival of flood water from the first point in the basin to the last point in it. As for LAG TIME 48HR, see figure (2), (3) from the researcher's work depending on WMS 10.1, Surfer 13, GIS, ARC Scene, and QGIS 3.8.

Figure 2. A hydrograph showing the runoff of AL-Zafran Basin for the years 1996-2018.

Figure 3. Shows the slope of AL-Zafran Valley.

7. Runoff Modelling with Hydro ACD for AL-Zafran Valley Basin

The total depths of rainstorms (annual averages) between 1996-2018 were about (865) mm distributed between the stations of Ali Al Gharbi, Ilam and Dahlran, and depths of (274,413,178) respectively over the entire area of the valley. It is estimated at 612.4 km² = (61240) hectares. The maximum depth of the daily rainstorm was 247 mm³. The amount of rain is distributed at different depths between Ali Al Gharbi Station in one day. 31 mm³, Ilam station (87 mm³) and Dhahran station 65 mm³. In light of this, the predictive estimate was calculated over a period of 100 years according to the HYDROACD program. See table (2). See figure (4) and is as follow
Table 2. Times of heavy rains at different depths and the occurrence of a 24-hour flood wave in AL-Zafran Valley Basin.

Table 2 shows that during a period of 20 hours, the amount of rain estimated at 247 m$^3$/s after the soil began to saturate for 10 hours, then the surface runoff speed began to rise to its peak. Until it became a torrential flood wave, which reached its peak at 12 am, and its speed reached between (1.5-3.7) (m$^3$/s), while its quantity was estimated according to the calculation of the program (3172) m$^3$/s, after the depth of the storm reached (191) m$^3$ Based on the data of the dominant study station. Whereas the peak rain peak was a form of intensity of rain that occurred in succession to reach its maximum to 235 m$^3$, while the maximum limit of increase was 47 mm$^3$, as well as TC = 61, CN = 40, so the flood wave coincided with the height of Precipitation is tracked in one hour. Consider Figure (4) (7) CAD Water Program.

Figure 4. Modelling the rainstorm waves and floods in AL-Zafran Valley Basin.
8. Conclusions
[1]. The study area is located within the harsh climate regions where the climate is dry and semi-arid.
[2]. The region is exposed to rain due to the depressions coming from the Mediterranean and the Red Sea, starting in October, and their frequency increases in the winter months (December, January, February), and weakens in May.
[3]. The study area is characterized by the fluctuation of rain intensity of the type of air fronts.
[4]. The largest amount of annual precipitation was recorded in Dhahran station if it reached (274) mm
[5]. The difference in the hourly amount of rain in the stations of the study area according to the intensity of rain, as the peak of precipitation increases (intensity of rain) as the center of the depressions approaches.
[6]. A simulation program for the frequency of rain intensity in the Zafran Valley basin recorded a predictive estimate for a period of (100 years). A variation in rain intensity was reflected for drainage in the valley basin
[7]. The rainstorm AL-Zafran Valley was analyzed and a curve was drawn to measure and calculate the amounts of precipitation, drainage and the depth of the rainstorm in light of the climatic data of the prevailing stations that monitored between an hour and a day. With variable chronology.

9. Recommendations
[1]. Establishing dams and reservoirs to reduce the risk of floods resulting from frequent rainstorms. Drainage and irrigation networks should be developed to reduce the risk of floods.
[2]. Designing water-harvesting projects for the purpose of collecting and collecting rainwater and using it in developing agricultural lands and raising their productivity. An increase in the number of climate control stations to achieve better results contributes to an increase in study in this field. The introduction of modern technologies contributes to reaching more accurate results and harnessing them to serve the agricultural and industrial development processes.
[3]. Adopting fluctuating rain quantities in the planning process for establishing agricultural, industrial and urban projects and reducing the risk of floods in the region. Establishment of water and climate stations in the study area to measure the volume of surface runoff over the valley basin. Establishing permanent artificial dams for the purpose of harvesting water and benefiting from it in times of water scarcity, especially in the summer.
[4]. Intensifying studies in this field and adopting modern software to quickly reach more accurate results due to its scarcity. Preparing detailed studies for the study area to study the risks resulting from torrents and floods to reduce their risks to the area.

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