ORIGINAL ARTICLE

Investigation of flood Hydro-climate in Qamsar river Basin via Mathematical and Statistical Techniques

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ABSTRACT

A flood phenomenon is one of the hydro-climate extreme events and one of the severely natural disasters, which threaten human societies. Frequently of floods in recent decade's causes to most country areas subject to invasion of periodic and destructive flooding and cause to increasingly increase in Casualties and financial losses .in expert discussions, it is said that decreasing Solid precipitation and or changes precipitation from solid to liquid as a result of climate changes , is one of the reason for increasing flood , but increasing population along with incorrect planning for exploitation from land , destroying jungles and pastures , developing Impenetrable levels cause to less water penetrate in earth in Watersheds and stream down –ward fast . As results, floods become more frequent, more severe and more sudden, and more people damage of it. The goal of this project is to investigate hydro-climate factors effect on happening flood via mathematics and statistical techniques on 86/04/06. in this project , in order to consider flood hydro – climate in Qamsar river basin on 86/04/06 via Google- earth in mentioned area and its river basin was identified and considered by Qamsar station precipitation statics between 1376-1389 and ?Bon-rod station between 1366 – 1388 for recent starvation and aggravated reasons of floods and its trend . So, we can said that flood in 1386 was Unprecedented during 50 years ago, which had a lot of Casualties and financial losses. Starvations in recent decades because of decreasing precipitation and uncontrolled removal of underground water and as a results Drying up of wells and aqueducts in one hand , and destroying natural resources and vegetation and , unauthorized manipulation and building house around and in bed of rivers in other hand , cause to increasing floods and losses due it .
Key words: Flood, Qamsar , Mathematical and statistical, Precipitation, Starvation

INTRODUCTION

Natural disasters such as flood, is one of the problems from past to present and always has been considered by hydrologists. One of the requirements of this phenomenon is identifying frequency and magnitude of disaster and public pre- information .relation among effective factors in happening of this phenomenon is non- linear and their analysis is complicated. Clearly, flood is known as a natural disaster, but, in practice, flood is one of the most important natural disasters in the world from Casualties and property damage. According to statics provided by United Nations; flood and storm had a most among natural disaster Casualties and property damage for human society among natural disaster, as if just in one decade, amount of damage due to flood and storm was about 21 billiard dollars against 18 billiard dollars damage due to earth quick. this is true for our country , and in several recent years about 70 percent of annual credits for Natural Disasters Effects Decreasing Plan and unexpected disasters was spent for damages due to flood . also , we should aware that safety of structures and facilities against dangers such as earth quick was increased due to improve construction and preserve regulations and rules , but, unfortunately natural trend of developing in countries such as Iran, cause to destroy natural resources and environment and in this way damages can develop increasingly due to flood. Growth of 250 percent of damages due to flood in recent five decade approve this   matter.

METHODOLOGY

In this project, in order to investigate flood hydro-climate in Qamsar river basin in 2010/04/06, we identify mentioned areas and its river basin via Google Earth, and recent droughts and reasons of flood

intensify and its trend was considered via precipitation data in Qamsar station between 1376-1389 and Bon-Rood station between 1366-1388.In this project, we use Excel and SPSS statistical software's and Statistical methods for double masses to determine verification of data and use SPI and moving average method to identify wet year and drought periods. There are many tests to insure data homogeneity and numbers which are analyzes such as double mass curve method. Also, Run test is one of the numerical methods that we apply it here.

Achievements

A review on kind of mathematical and statistical models River flow behavior is formed under different process in time and place. To identify these phenomena and effective factors on it, it is crucial to select appropriate tools for analyzing and considering this matter. In analyzing river flow and flood, statistical and mathematical models play an important role as a appropriate tools. In statistical and mathematical models, physical process is analyzed quantitatively and via differentia equations solution numerical methods governing to flood flow. Developing computer system from one hand and develop in equations solution technique governing to flow hydraulic from other hand , cause to provide several mathematical and statistical models to simulate different river phenomena. These modals involved wide range of applied aspects such as routing of flood, flood zoning, study characteristics of flow hydraulic, and considering sediment transport.

Introducing area under study

Qamsar is a place that in terms of geometrical condition, is located in 510 26' eastern length and 330 45' in northern latitude. This town has an average altitude of 1900 meters from sea level and it is like a green belt with several arms along less – slope valleys of Iran central section mountains .Qamsar in terms of geographical limits is in Esfahan province administration – political limit and in term of provincial division, is one of subdivision of kashan city. Qamsar is a central and urban area of Qamsar in mountains of southern parts in Kashan. Qamsar section has a 25 villages with inhabitants and including two towns which are called Qamsar and"Josheghan Kamoo" and rural districts of "Qohrood" and" Moslem Abad" and 'HOssein Abad' , "Ghazaan" and "alzagoklok"h .Qamsar is located in 30 kilometers from Kashan and in 160 kilometers from Esfahan – from"Qohrood" road- and 180 kilometers from Esfahan – from Tehran- Kashan high way -, which with regard to considerations of "Mr.Manochehri" for constructing of Qamsar-Kashan high way , today's many tourism and travelers can travel to this town easily and safety (Qamsar crisis management comprehensive plan) .
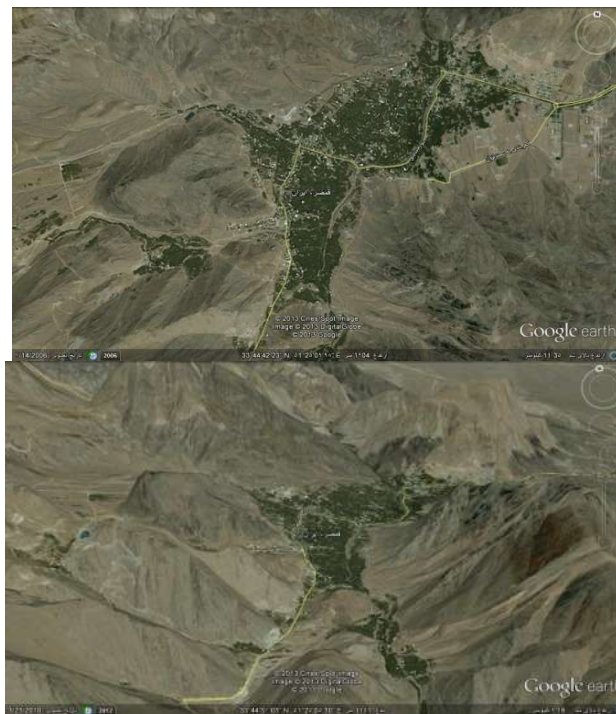
Figure 1 : geographical situation of area under study

Qamsar and general characteristics of Qamsar river basin

Basin or watershed is derived from southern altitudes of Qamsar. These altitudes is cold and full of snow and its highest peak is Karakas (high peak) with 3588 meters high (in Karakas row), and it is stable

aquatic center and feeder resource of surface and underground waters in Qamsar and areas around it QamsarRiver starts from altitudes in 300 meters of southern section of "Joreh", and passes through Qamsar in 1100 meter high toward Kashanplain, and finally flows to its runoff in Qom route. Among surface water in this basin Qamsar river is the most important surface water flow , which from one hand , is flow all of the year and in other hand , has a many flow changes and include 6 atmosphere according to historical and real estate division and base on average limit of watering in summer [1] .

Figure 2: condition of Qamsar river basin on satellite picture

Figure 3: situation of Qamsar river basin in city plan

Aqueduct

Investigation about geographical diffusion and number of Aqueducts in Qamsar green valley show that in this water retention area , inhabitants actions range is so wide that in spite of many resources of water in the area and low population , more than 92 Aqueducts was drilled and apply from available underwater resources ; as it was possible .these Aqueducts extended from the most bottom area of basin part – "Farfahan" and "Darla"- in the north , to ends of valleys across from "Sar-bisheh" spring and"Joreh" river in the south .it is said about general characteristics that : length of these Aqueducts begin from several meters and the largest one is "TOT" Aqueduct and then " Jazavand" Aqueduct (up) that reaches to more that 1100 meters and its main well depth is a 54 meters.

Well:

Exploitation background from underground water did not refer to recently, but there were a few wells in the past, which just used for drinking and depth of them was low. Since electro pump was emerged in the area – especial after fifth decade – there was an increased in drilling depth and mid-depth wells in all part of this narrow valley. According to the researches, more than 350 depth and mid-depth well ring was drilled in the town. This increasingly trend is in a way that now amount of mid-depth wells is more that depth wells and many governmental organizations drills them. Atlast, we can say that: more than 25 private and governmental depth and mid-depth with a flow more than 5 liters per second is active in the town and the rest of them are in a lower level rather than this.The result of this process is decreasing 20 meters in underground water table in recent two decades and severe loss or dryness in flow of most aqueducts in the area which its outcomes is raising increasingly, as if it was announced in a Comprehensive Plan of city water, that table of this area is critical.

Different mathematical modals

Generally, we can divide mathematical and statistical models in river engineering to two parts:

A - Time

1- Permanent flow: flow hydraulic parameters to stable time.

2-Temporaryflow: flow hydraulic parameters to variable time.

B- Place

1- one- dimensional: hydraulic parameters are varied just in length.2- Two – dimensional: hydraulic parameters are varied just in length and one other dimension.

3- three- dimensional: hydraulic parameters are varied just in three dimensions.

Trend of influencing flood in rural and municipal places in Iran

Flood risk was increased during recent years especially in rural areas , which was due to changing interferences and human actions in environment ecology structures , increasing population in flood plains and deforestation and etc , and it was presented many approaches to decrease these disasters in every period with regard to society development level .in a fact , until now , applying management patterns could change somewhat rural people condition to environment and also enjoy their experienced and capable in flood management . About this matter, flood and its occurrence focus on new patters of planning management those pay attention to both structural and un- structural management. So, in present study, we apply cooperative approach to manage flood in rural areas in order to non- structural management and its combination with structural management. This approach can acts as a flood prevention factor and even it is effective in other condition of flood occurrence after or during it [2].
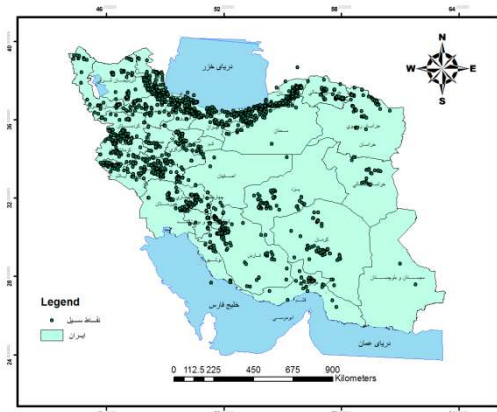
Figure 4: Map Of Area Prone To Flooding In Iran

Investigation of flood in 1335:
The last data of occurrence flood before 1386 is referred to Mordad 5th 1335 that as survivors expressed: in that year, there was a great flood in that year and had a many damages including fatality, which was due to less- depth of river or lack of tall walls and do not preserve construction in river basin. Qamsar dam river became full due to flood in this year, and because none dredging and destruction, this dam is inactive. In the following figures, we show Qamsar condition in next eight years after flood of 1335.
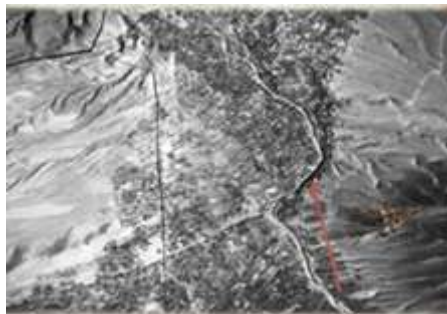
Figure 5: Qamsar river condition after eight years of flood in 1335
Investigation flood of 1386:
Wednesday inTirsixth, was a dark and terrible day for rural district people around Qamsar and central section of Kashan. There was a heavy and terrible storm and followed with several days raining caused to destruction flood in 15 meters altitude ND SPEED OF 12 kph and city of flower and rose water changes of Qamsar and rural sections of it destroy completely and remained a lot of human and financial losses for them .
Investigation of climate condition in area under study
Precipitation amount in Qamsar differs from Kasha precipitation, and it has a high average amount rather than mountain stations. Altogether , in terms of climate ,the city gardens , shadow of trees , and flowing water streams provide a pleasure situations and there is nice weather condition in desert edge due to atmosphere relative high moisture , cold winter with a mild cool and moderate summer , which is the most prominent property of this city , because it was famous in all historical , economic, social and cultural areas as a positive element for developing city [3] .
Occurring showery rain
The results of recorded precipitation in Pluviometer stations are as follow:

1- Raining begins in fourth day of Tir month and continues to ninth day,2- the most rate of recorded precipitation in stations for whole of six days precipitations with 59.5 millimeters was related to Bon-Rood station and next for "Zanjanbar" and "Qohrod".
3- the most precipitation of daily was 42 millimeters and was related to Bon – Rood station and after that for "Qohrod" with a precipitation altitude of 35 millimeters.
4- Heavy precipitation that cause to flood in this area, mainly precipitated in the afternoon. [4].

Table 1: recorded precipitation in 2006/01/04 to 2006/09 in Kashan stations (millimeters)

total	Day												station	row
	9		8		7		6		5		4			
	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM		
59.5		2		2	1.5	5.5	42		4.5		1	1	Bon rood	1
23.5	.		1.5			1.5	12		7.5				Qamsar	2
9.6				0.6		1.6	1	0.4	4		2		fin	3
10.5			3		2	2			3.5				Sen-sen	4
13							10		3				Mohammad-Abad	5
21			6.5		8		4		2.5				Alavi	6
42	5			1		3	7	1	23		2		Barzok	7
16				1	2	6	1		5		1		Hossein-Abad	8
7							2.5	1	3.5				Noosh - Abad	9
50							35			15			Qohrood	10
51			2			10	30		6		3		Zanjanbar	11
21.5		2.5		1	7.5		5.5		3		2		Niasar	12
8.5								1.5	1.5	1.5		4	Water affair	13

Resource: (Kashan water resource affair)

Investigation of recent drought
In this project, we use Excel and SPSS statistical software and Statistical methods for double masses to determine verification of data and use SPI and moving average method to identify wet year and drought periods.
Investigation of data verification
There are many tests to insure data homogeneity and numbers which are analyzes such as double mass curve method. Also, Run test is one of the numerical methods that we apply it here.
Double mass method
Double mass curve method is applied to prevent from using false statics and considering randomness of statics and homogeneity test of precipitation in all stations.
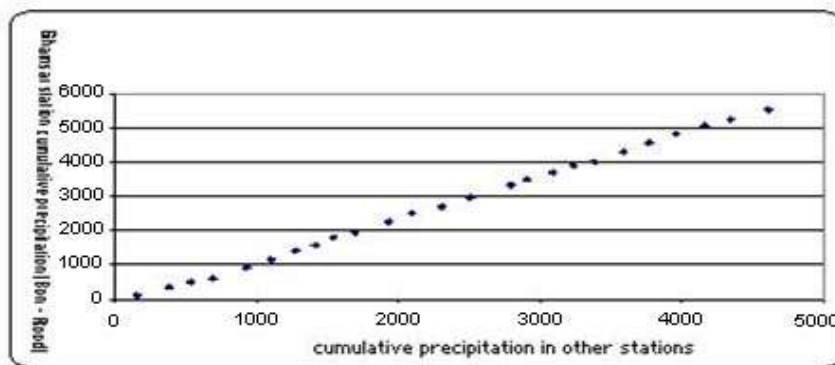
Figure 6: double mass curve diagram in Qamsar station (Bon-Rood)
Moving average method

Moving average method is applied for determining precipitation changes and wet year and drought periods .according to world meteorological organization recommend: in this method we should use moving averages 3,5and 7years . so , we can average precipitation rate for periods of 3,5,7 years , then we draw the diagram of moving average and then draw line related to average precipitation in every station to separate humid and dry periods .
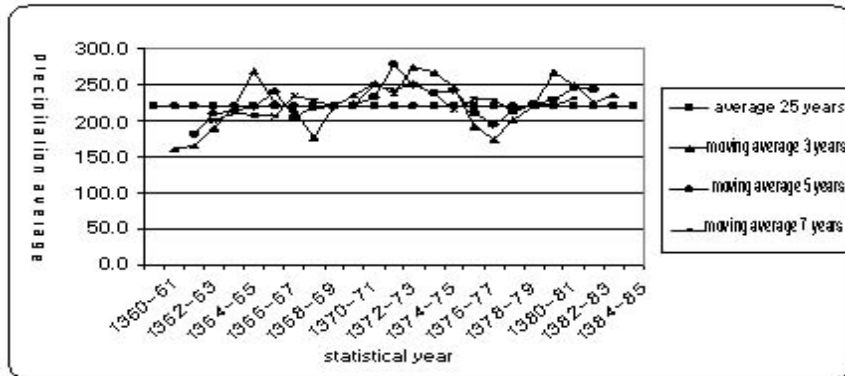

Figure 7: annual moving average diagram of 3, 5, 7 years in Qamsar station (Bon –Rood)

Standard precipitation index method SPIs
Standard distribution index is one of the important world indexes which determine occurrence probably of drought and wet year. This index was introduced by MC Key and et al (1993). In this method, we use following equation (1-1):

$$SPI = \frac{Pi - \overline{P}}{SD}$$

Where
SPI: precipitation standard index score
PI: annual precipitation average during especial period (millimeter)
P: precipitation long-term average during especial period (millimeter)
SN: data standard deviation
In this method,with regard to computation index amount and via table number3, we can determine drought and wet year and classify them.

Wet year or drought degree	SPI amount
Very very humid	2 and more
very humid	1.5 to 1.99
Relative humid	1 to 1.49
Nearly natural (near to normal)	-0.99 to 0.99
Relative dry	-1 to -1.49
Very dry (severe drought)	-1.5 to -1.99
Very very dry	-2 and less

Table 3: classification of standard precipitation index SPI
Drought is a natural intangible disaster that occurs following low precipitation during a long – time or short – time. Although some believe that drought is a random and rare event, but this phenomena occur nearly in all of climate areas, and its properties is different place to place. Qamsar station shows that drought between 1376-1389 was about 59 percent .the most severe drought is referred to 1376-1377 with 132.2 millimeters and the most drought continuity was between 1376-1379. While in Bon-Rod station, amount of drought between 1368-1388 is about 60 percent. This statics shows high effects of recent drought due to lack of precipitation and drying aqueducts and wells and uncontrolled harvesting of under ground water in flood 1386.
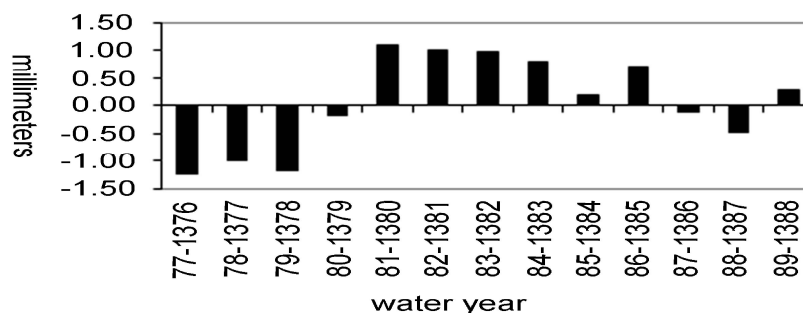
Figure8: diagram for identifying wet and dry years in Qamsar between 1376-1389
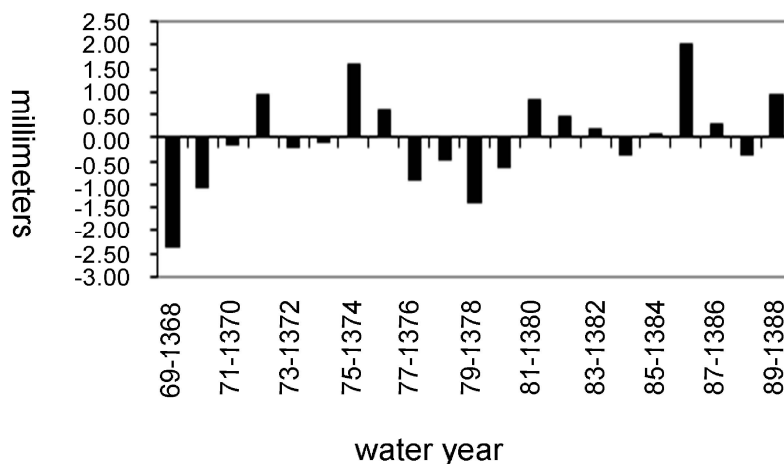
Figure 9: diagram for identifying wet and dry years in Bon-Rood between 1989-2008

Reasons for intensifying flood losses in area

1 – Unauthorized manipulation in watercourse and river bed and around2 – Destroying natural resources and vegetation in the area due to recent drought from one hand and uncontrolled development and unauthorized manipulation by human factor from other hand .due to decreasing vegetation and changing land use, run off because of precipitation increased in some places up to 30 times, and in some areas with a steep and erosion soil, in terms of geology, cause to displace mud and bring heavy losses .we can mention to it as one of the important factors.

3 –Lack of attention to warn and predict flood and take an appropriate measurement against it via related systems and people.

4 – Inactiveness of Qamsar dam due to flood 1956 and lack of dredging and restoration.

CONCLUSION

Consequently, we can say that flood 1386was Unprecedented in the recent 50 years and remain many Human and financial losses. Recent drought due to low precipitation and uncontrolled exploitation from underground water and finally drying wells and aqueducts from one hand and destroying natural resources and vegetation , and unauthorized manipulation and building house in river bed from other hand , effect on occur flood and increase losses.

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