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### STUDY ON CONSEQUENT FLOOD OCCURRENCE IN A PART OF NORTHERN IRAN

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#### ABSTRACT

Among all of the natural disasters, flood occurrence has become as a common phenomenon in undeveloped as well as developing countries during last decade. It is clearly understood that the increment rate has not been made due the significant changes in natural reasons, since not much variations occurred in such an affective factors. Ever increasing population living in or utilizing of watersheds has definitely increased the demands for more supply of food, wood and fuel. Providing the lowest level of people requirements needed unordinary exploitation of resources and in the other words more encroachments to the nature. The resultant of such unbearable forces on the nature made it very susceptible and ultimately fragile that caused very fast hydrologic response in the form of floods and droughts. Under these circumstances, the people were also been vulnerable, since they could get the lower standard living limits difficultly. Therefore, it can be concluded that the people i.e. watershed habitants, experts and decision makers have a crucial and an important role in the omission or the mitigation of un-wished phenomena.

In the present paper, an attempt has been made to investigate the main reasons behind the consequent and frequent occurrences of flood in the Golestan province located in the northern part of Iran during years 2001 and 2002. More than 600 were tolled and most of the Golestan National Park and downstream villages were flooded during the above mentioned floods. The floods had mostly been initiated from the Madarso watershed having an area of 1800km<sup>2</sup> initially covered by forests and ranges and presently cultivated by linear crops such as sunflowers where much amounts of runoff was created. The problem was then exaggerated when the runoff reached unsuitable and un-well planned structures and made it as a historical record in the area. The more details of the study on the reasons and recommended policies have also been presented in the paper.

**Key words:** Flood, Non-structural measures, Comprehensive Management, Golestan Park, Iran

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## INTRODUCTION

Water is widely regarded as a free good, a commodity supplied to everyone by “nature”. Sometimes the mentioned commodity may appear as a main source of problems in the form of uncontrollable runoff named as flood. Many people have been tolled due to natural as well as artificial phenomena among which floods, storms and earthquakes are the important ones. Flood protection was a major issue of the 1960s and 1970s. As funds were committed for both structural and non-structural measures it was realized that flood damages continued to rise (Cordery, 2000). About 390000 people were killed because of natural disasters during 1988 to 1997 out of which 58% belongs to floods whereas the contribution of earthquake and storms is 26 and 16%, respectively. During 1980s, at least 60 floods were reported throughout the world having more than 100 tolls in each and in 10 cases the number of deaths was beyond 1000(Najafinezhad, 2003). Ever increasing of population and properties within floodplains, hydro-system changes and destructive role of human activities are important reasons causing incremental trend in flood occurrence (www.iranflood.com, 2003). Almost 6% of victims throughout the world belong to Iran and it also stands among one of the 10 most damageable countries in the globe. More than 40 natural disasters have been recognized, out of which 31 could be found in Iran. The numbers of flood occurrences as well as the economic damages have been geometrically increased during last decades in Iran. The annual increment rate in flood numbers and hazards during last four decades in Iran have been reported some 7 and 9 percent, respectively (Deputy of Watershed Management, 1999). The floods occurred in the north of Iran, mainly covered by forest and governed by humid climate, during last few years are much of interest for concerned people and therefore one of the important one is discussed in the present paper.

## GOLESTAN FLOODS

The recently established Golestan province is located in northern part of Iran and is very famous in view point of agricultural productions specially cotton. This area is faced with lots of flood-related problems and became as the worst affected province as well as an interesting hydrological lab for related specialists. Based on information reported by UNDP(2001) and local investigations as well the total number of people directly affected by the floods in the province specially following the region's worst flooding in 200 years occurred on August 10 resulted from an about 10h rainfall having a depth of 170mm was 217,796, out of which 10,000 are homeless although close to 1.2 million people have been directly or indirectly affected by the floods at varying degree. About 387 villages have been affected and 4,000 buildings have sustained heavy damage. The deluge submerged some 15,000 ha of farmland (www.dawn.com,2001) and 10,000 ha of forest and pasture land. The damage was estimated to run into tens of millions of dollars. Due to water logging, malaria and diarrhea were of health concern in the affected areas. The number of deaths registered was some 600 in the province.

Another catastrophic flood was also occurred as a resultant of relatively heavy rainfall almost at the anniversary of pervious flood on August 11, 2002 in the same rejoin but in different watershed. The number of tolls was reached only 40, all passengers of a bus falling down into a broken bridge. The total damage of the second flood was comparatively much lesser because of following reasons:

- Much of the properties have already been damaged in last flood
- The preparedness level for relief missions has been sufficiently improved
- The magnitude of storm generating runoff was much lesser than of that in last flood

- The susceptibility and vulnerability of the watershed area burden flood was less in comparison to area inundated in pervious flood.

The floods have been initially created owing to intense rainfall in upstream area of Gorganrood (Madarsoo) watershed, Kalposh and Robat Gharahbill rejoins, having semi-arid climate, spare vegetation cover and shallow deep soil even outcrops. The generated flood was then passed the intermediate part of the watershed, Golestan National Park up to Kalaleh City, and caused main damages and finally benefited downstream area through storing large amount of water behind Golestan dam. The intermediate rejoin dose not have much contribution in runoff generation, since a dense forest stands cover the area. Adversely, the downstream part of the watershed comprise steep slope area covered by agricultural cover and are mostly bare when the summer intense storms occur and therefore generates high rate of runoff and soil erosion. The unsorted loess soil and linear cultivation facilitate conditions for high rate of runoff generation and soil erosion as well.

Locating the national Gorgan-Mashad road neighboring main river, in most parts, cause major structural losses in first deluge and renewed in the next flood, since the road was reconstructed in the same place with the low level of design accuracy and safety.

The flood mainly originated from the upland area where cyclonic summer intense storms occur and the runoff coefficient is also very high. The generated runoff then moves towards downstream and deroots small plants and trees besides eroded soil and ultimately creates debris flows. The debris flow then faces with unsuitable and incompatible cross structures, mainly bridges, and clog them easily. The pounded volumetric water creates lot of hydrostatic pressure, which either breaks the bridge or reopens its way and in both the cases generates artificial floods. The flood thus submerges and washed away whatever found in the prohibited and restricted zones and enforces people to bear tangible and intangible losses. The investigations and the field studies showed that the main reason of flooding in both the years was intense rainfall precipitated on steep slope area with weak land use planning system which had been exaggerated through failure of mismanaged projects and high level of people vulnerability. The natural frontage of drainage system particularly the main waterway (Gorganrood) had also been encroached that itself makes condition more susceptible and sensitive. Pictures 1 to 7 show the severity of flood and related damages.

## **SOLUTIONS**

According to investigations, field surveys and data analysis regarding flood occurrence in eastern part of the Golestan Province the following suggestion can be offered for flood mitigation workable in immediate, short and long terms.

1. With the effect of climate change and global warming, more and more floods are expected. We should therefore join our forces on prevention, mitigation and preparedness. The most convincing argument why we should prevent, rather than respond to disasters is in their sheer human and financial costs (Devaud, 2003).
2. Since the design and implementation of every flood control activity such as forecasting systems and engineering structures need detailed and accurate data, equipping the watershed with pertinent climatological and hydrometrical stations for collection of accurate data is necessary.

3. A comprehensive study is also very essential to prioritize different parts of watershed in flood generation as well as effective factors.
4. Design and reconstruction of appropriate and suitable structures such as ford instead of bridges, road cross drains and selection of proper hydrologic design may be as another applicable technique for prevention of flood damages in the study watershed.
5. Structural measures such as dams may have a crucial role in flood impacts control as Golestan dam did in case of occurrence of floods in August 2001 and 2002 in the study area through attenuating the flood peaks from 3000 and 600 m<sup>3</sup>/s to 300 and zero m<sup>3</sup>/s, respectively (Mosaedi *et al.*, 2003) and therefore prevented a human disaster in the Gonbad city located almost 12 km far from the dam site and a lot of damages to properties situated in floodplain up to the Caspian Sea and therefore extension of applying such techniques during a long time is advisable.
6. Besides international financial assistances and helps, the continuation of scientific meetings such as International Seminar on Flash Flood Prevention and Mitigation held in Gorgan, the province capital, on 15 and 16 January, 2003 and jointly organized by UNDP and Ministry of Interior of Iran, (2003) is certainly helpful to find root reasons of flood occurrence and the sound protection techniques as well.
7. Executive coordination between provinces having common watersheds viz. Golestan, Khorasan and Semnan in Golestan flood control is also a must, which has to be kept in consideration.
8. In the study area, the torrent control through which the precipitated rainfall is controlled at the fall place is much preferable and economical than flood control.
9. Increasing the transportation capacity and the training of the main river through cleaning, cutoff, debris collection, jetties, guide bank and floodwalls are other techniques approachable during short time.
10. Public participation is another efficient approach which has to be kept at the top of decision making to let the people to share problem among themselves and find out the most desirable technique for flood control in the area under consideration where many different communities and tribes exist.

## CONCLUSIONS

It is neither economically possible, nor environmentally desirable to eliminate flood risks. Rather the need is to learn to live with the floods that inevitably occur and to ensure that the benefits of our lifestyles on flood prone land exceed the costs exacted by the occasional but traumatic floods, and to ensure no sections of the community are disadvantaged while others gain significant benefits.

It can also be concluded that the floods occurred in the consequent years have had the same mechanism and the potential for their repetition remains high until the managerial system is similar to that nowadays exists. The statement is easily verified, since the natural reasons viz. summer intense storms, steep slope and soil conditions for flood generation is out of human control whereas amplifier factors can be logically and economically controlled.

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**Picture 1** Human encroachment to main river frontage



**Picture 2** Un-well designed cross structure on main river



**Picture 3** Debris flow created during Golestan flood



**Picture 4** Flood marks left on trees



**Picture 5** Uprooted trees and bushes left in the main river



**Picture 6** Washed out bridge constructed on main road



**Picture 7** Established tents for flood harmed people