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The Study of Hydrological Model in Implementing Flood Management in Sistan and Balochestan Province (Catchment Area: Dashtyari and Gasrgand) Iran

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ABSTRACT: *This research conducted over the flood risk management seeks to reduce the risk from flood events to the people who are located in flood prone areas such as; Dashtyari and Gasergand Balochestan. However, there are some level of risk to all locations within the floodplain. The magnitude of that risk as function of the flood hazard, the characteristics of a particular location (its elevation, proximity to the river or coast, and susceptibility to fast-moving flows and surges, etc), measures that have been taken to mitigate the potential impact of flooding, the vulnerability of people and property, and the consequences that result from a particular flood event. Flooding is the most devastating natural hazard in Balochestan (Makoran) and the recent flooding has demonstrated its severness. Floods are common throughout the all country. But, their characteristics differ from region to region. Flooding behavior of the major basins and flood management at the national level are investigated in this article. Monsoon rainfalls are the main source of floods in the Indus Basin, while Mediterranean Waves and Cyclones, which are generated over the Balochestan, induce flooding.*

KEYWORDS: *Flood, Hydrology, Intensity, Dashtyari, Management, Mitigation, Risk and Planning.*

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I. INTRODUCTION

Floods can be described according to speed (flash flood), geography or cause of flooding. Floods are among the most common and destructive natural hazards causing extensive damage to infrastructure, public and private services, the environment, the economy and devastation to human settlements. Recurring flood losses have handicapped the economic development of both developed and developing countries. Floods usually are local, short-lived events that can happen suddenly and sometimes with little or no warning. They usually are caused by intense storms that produce more runoff than an area can store or a stream can carry within its normal channel. Rivers can also flood its surroundings when the dams fail [1].

In a broader sense, normally dry lands can be flooded by high lake levels, by high tides, or by waves driven ashore by strong winds. Small streams are subject to floods (very rapid increases in runoff), which may last from a few minutes to a few hours. On larger streams, floods usually last from several hours to a few days. A series of storms might keep a river above flood stage (the water level at which a river overflows its banks) for several weeks [3]. The climate of the region varies from sub- tropical arid and semi-arid to temperate sub-humid in the plains of Makoran Dashtyari in the Sistan and Balochistan. A location plan is shown in figure (1).

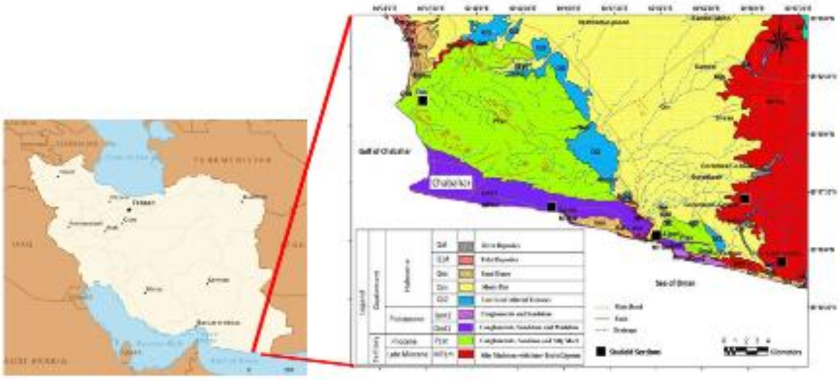

Figure 1: Study area of Dashtyari Makoran (Sistan and Balochestan) region under flash flood 2020, Iran

Flash floods are associated with short, high-intensity rainfalls, mainly of convective origin that occur locally. As such, flash flood usually impact basins less than 1000 km^2, with response times of a few hours or less. The time dimension of the flash flood response is linked, on one side, to the size of the concerned catchments, and on the other side, on the activation of surface runoff that becomes the prevailing transfer process. Surface runoff may be due to different generating processes, owing to the combination of intense rainfall, soil moisture and soil hydraulic properties. It may be also enhanced by land use modification, urbanization and fire-induced alteration. Analysis of flash flood processes is important because these events often reveal aspects of hydrological behaviour that either were unexpected on the basis of weaker responses or highlight anticipated but previously unobserved behaviour [2 - 4]. Characterising the response of a catchment during flash flood events, thus, may provide new and valuable insight into the rate-limiting processes for extreme flood response and their dependency on catchment properties and flood severity. Moreover, local flood-producing processes are more amenable to analysis in the typical small-scale flash flood basins than in larger catchments where the regional combination of controls can be relatively more important [9 - 11].

II. MATERIALS AND METHODS

The study was conducted in two different and the biggest dams at Zirdan and Pishin in Balochestan. The area is located near the borders of Iran and Pakistan. Thus location up on which this study concentrates is bounded by the coastline of southern Iran and Western of Pakistan, approximately, by the line of latitude 25 degree to the South and the line of longitude 60 degree to the west. The area consists of an inland chain of steeply sloping bare rock (mountains) which drain onto a coastal alluvial plain. The analysis is based on a multi-sites analysis approach, since the two rivers locations are not considered sufficiently similar to be pooled together [7].

However, remote sensing technology has played an important role in flood monitoring in recent years. This development (optical/aerial to radar remote sensing) provides all weather capability as compared to the optical sensors for the purpose of flood mapping. Flood mapping is one of the techniques used for flood monitoring in which pre- and post-flood images are compared to classify undated non-flooded and inundated flooded areas [10] .Therefore, flash flood disasters occurred in Gasrgand district on cities on 20/1/ 2020 which is illustrated in figure (2).

Figure 2: River Kajoo Overtopped levee at District Gasergand (Makoran) during flash flood 20/1/ 2020

Floods are one of the most common hazards in the Iran also in the Sistan and Balochestan South of Iran. Flood effects can be local, impacting a neighborhood or community, or very large, affecting entire river basins and multiple states. However, all floods are not alike. Floods themselves average four billion dollars annually in property damage alone. Floods develop slowly, some-times over a period of days. Flash floods can develop quickly, sometimes in just a few minutes and without any visible signs of rain. Flash floods often have a dangerous wall of roaring water that carries rocks, mud, and other debris and can sweep away most things in its path. Overland flooding occurs outside a defined river or stream, such as when a levee is breached, but still can be destructive [15 - 17].

III. FLOOD CONTROL AND DISASTER MANAGEMENT

Flood disaster management, in Dashtyari region which involves prevention, mitigation, preparedness, response and rehabilitation efforts, has been discussed for a long time. In short, such management tools can be classified into before, during and after event activities within the scope of disaster risk management cycle, for which the flood disaster preparedness can be referred to all measures to prepare before the events. Furthermore, evidence of increasing heavy precipitation at continental and global scales supports the view that the global hydrological cycle is intensifying as the planet warms. As a consequence, the flash flood hazard is expected to increase in frequency and severity in many areas, through the impacts of global change on climate, storm–weather systems and river discharge conditions [11 - 19].

It is important for those are located in the floodplain and those responsible for activity in the floodplain (public officials, investors, and those relying on activities in the floodplain, etc.) to ensure that those in the floodplain understand the nature of the risks they face and the steps that may be taken to reduce this risk [5]. In communities that are part of the National Flood Insurance Program (NFIP), those portions of the community located in the Special Flood Hazard Area (SFHA) [21].

Flash floods are associated with short, high-intensity rainfalls, mainly of convective origin that occur locally. As such, flash flood usually impact basins less than 1000 km^2, with response times of a few hours or less. The time dimension of the flash flood response is linked, on one side, to the size of the concerned catchments, and on the other side, on the activation of surface runoff that becomes the prevailing transfer process. Surface runoff may be due to different generating processes, owing to the combination of intense rainfall, soil moisture and soil hydraulic properties [20]. It may be also enhanced by land use modification, urbanization and fire-induced alteration. Analysis of flash flood processes is important because these events often reveal aspects of hydrological behaviour that either were unexpected on the basis of weaker responses or highlight anticipated but previously unobserved behaviour [14]. Characterising the response of a catchment during flash flood events, thus, may provide new and valuable insight into the rate-limiting processes for extreme flood response and their dependency on catchment properties and flood severity. Moreover, local flood-producing processes are more amenable to analysis in the typical small-scale flash flood basins than in larger catchments where the regional combination of controls can be relatively more important [22].

Flood control refers to all methods used to reduce or prevent the detrimental effects of flood waters. Some of the common techniques used for flood control are installation of rock berms, rock rip-raps, sandbags, maintaining normal slopes with vegetation or application of soil cements on steeper slopes and construction or expansion of drainage channels. Other methods include levees, dikes, dams, retention or detention basins. After the Flood Disaster that happened in 2006, some areas prefer not to have levees as flood controls [20].

Such projects are altering delicate ecological balance, enhancing environmental degradation, exacerbating conflicts over resources and enhancing power inequities within the country [12]. Therefore, flash flood disasters occurred in Sistan and Balochestan Dashtyari regions on cities on 19/1/ 2020 which is illustrated in figure (3).

Figure 3: River Kajoo Overtopped levee at District Dashtyari (Makoran) during flash flood 19/1/2020

IV. ZONING OF FLOOD-PRONE LANDS IN DASHTYARI

The best way to reduce future flood damages in Dashtyari is to prevent development from occurring on flood-prone lands. Zoning of such lands is an effective approach, but generally should be coupled with the broader land-use planning mentioned above so that the land has a defined use. Zoning can be used to reduce damages from flooding and be flexible enough to recognize that other forms of land use are compatible. An example is agricultural use of lands in flood-prone areas where water velocities are low enough not to cause serious erosion. Flood-prone lands can continue to be used for agricultural purposes, particularly in country sides where the amount of agricultural land is limited and self-sufficiency in food supply is a national goal [5].

It is important, however, to ensure that the supporting dashtyari district infrastructure such as houses are located away from the flood-prone area or flood proofed. It is also important that livestock, machinery or stored crops can be evacuated quickly from the area in the event of a flood. This underscores the importance of a flood forecast, warning and response system. Zoning of flood-prone lands as ecological reserves or protected wetlands can often help to meet broader environmental or biodiversity goals. In addition, such lands often play an important role in sustaining the fishery, and they can also act as temporary storage and infiltration areas. Riparian buffer strips also reduce the movement of agricultural chemicals and nutrients into the aquatic system [6-7].

V. RESULTS AND DISCUSSION

Sistan and Balochestan is protected from flooding by a huge mechanical barrier across the River Kajoo which is raised when the water level reaches a certain point. Dashtyari (Chabahar) has a similar arrangement, although it is already unable to cope with very high tides. The defenses of both Balochestan and Makoran will be rendered inadequate if sea levels continue to rise [7-18]. The largest and most elaborate flood defenses can be found in the Gasergand and Chabahar districts, where they are referred to as Delta works with the dam as its crowning achievement. These works were built in response to the Balochestan flood of 2014, in the south western part of the Sistan and Balochestan. The Iran had already built one of the largest dam in the south of the country named the Zirdan dam in Dashtyari [22]. Therefore, the combined rainfall data set yielded for each areas of Gasrgand and Dashtyari districts which is shown in figures (4 and 5).

In Iran, flood diversion areas are rural areas that are deliberately flooded in emergencies in order to protect cities. Many have proposed that loss of vegetation (deforestation) will lead to a risk increase. With natural forest cover, flood duration should decrease, (citation needed) Deforestation amplifies the incidents and severity of floods. There are many disruptive effects of flooding on human settlements and economic activities. However, flooding can bring benefits, such as making soil more fertile and providing nutrients in which it is deficient [18].

The study finds water management, including equitable water transfers and stakeholder cooperation, addressing population growth, and locating additional water supplies, as more problematic than the challenges posed by climate change. Maintaining its strong, engineering-based water management tradition, and at the same time institutionalizing a framework for a more holistic flood risk management that comprises not only rules and regulations for probability reduction but also for impact reduction through sustainable spatial planning turns out to be a challenging task [9]. The recently established national flood control could be an important stimulus for the further integration and innovation of water management and spatial planning. To calculate runoff from Dashtyari catchment areas by methods such as the rational or modified rational method, though data connecting heavy rainfall intensity and its peak flash flood occurred by that rainfall which is illustrated in figures (4 and 5).

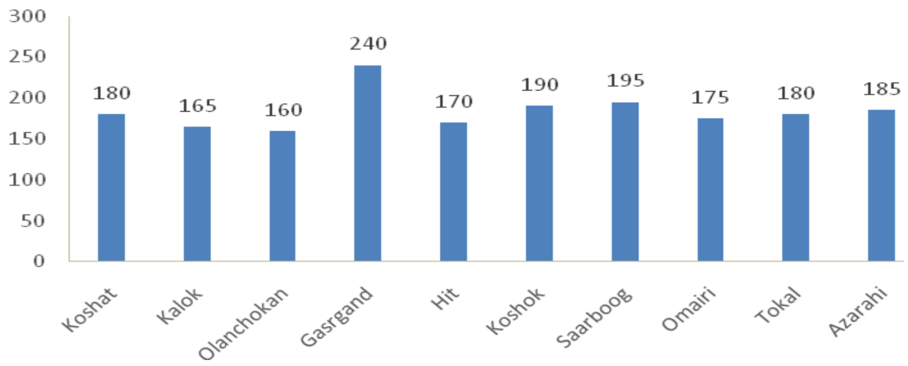

Figure (4): Rainfall Intensity for two days duration in Gasrgand District, flooded 19/1/2020 in Balochestan, Iran

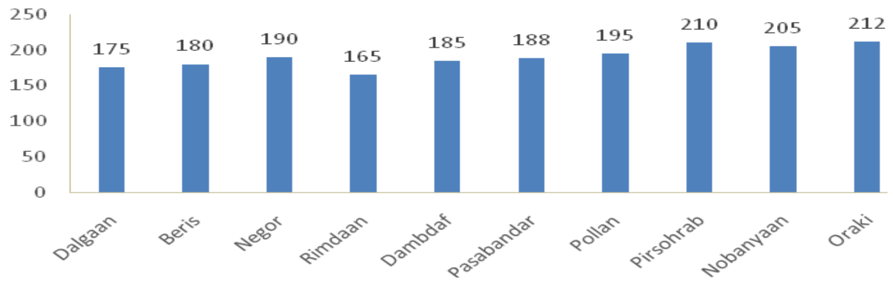

Figure (5): Rainfall Intensity for two days in Dashtyari District, flooded 19/1/2020 in Balochestan, Iran

VI. REDEVELOPMENT OF FLOOD-PRONE AREAS IN DASHTYARI

A major flood disaster is sometimes an opportunity to correct the planning errors of the past. Removal of flood-prone development and conversion of the land to a conforming use is an option to consider. It may be less expensive in the long run to physically relocate flood-prone development, buy it out as part of a disaster assistance program, or include its purchase in long term planning [16 -21]. The success of the latter approach can be enhanced by measures such as prohibiting improvements not required for health and safety, placing caveats on the land title, and by obtaining rights of first refusal on resale such as Bahowkalat area. Compensation and incentives Compensation as part of disaster assistance should always have as a goal the reduction of future flood damages. Rather than simply paying for damages, the funds should be focused on flood proofing, buy out, relocation and public education on the risks and consequences of living on flood-prone lands such as Oraki area [3].

In a similar manner, incentives can be developed that encourage flood proofing or relocation in Gagarok area, and these can be financed through cost-shared programs. Here the cost of flood proofing can be shared in proportion to the benefits to the various levels of government of not having to compensate for future flood damages. Property owners should also be expected to pay a reasonable share in view of the enhanced value of a flood-proofed structure and the reduced inconvenience after a flood [13 -19]. Land exchange programs can be used as an incentive to relocate from flood-prone lands. In such cases a public entity makes alternate land available and disaster assistance is generally used to pay for relocation or replacement of structures, depending on the costs and benefits. Incentives can also take the form of penalties. For example, if an individual is aware of the risk of flooding through such programs as flood plain delineation, or caveats on land titles, and still decides to build on flood-prone land, then that person should bear the consequences of his/her actions and not be eligible for disaster assistance. However this is difficult to enforce and is reliant on strong political will at the time of announcing disaster assistance [11].

VII. LAND USE PLANNING

Insurance is an option that needs to be considered, but is probably not feasible in many developing countries like Iran at this time. Branch of physical and socio-economic planning that determines the means and assesses the values or limitations of various options in which land is to be utilized, with the corresponding effects on different segments of the population or interests of a community taken into account in resulting decisions. Even when rainfall is relatively light, the shorelines of lakes and bays can be flooded by severe winds such as during typhoons that blow water into the shore areas. Coastal areas of Chabahar in Gowatr and Pasabander are sometimes flooded by unusually high tides, such as spring tides, especially when compounded by high winds and storm surges [22].

VIII. EFFECTS OF FLOODS

Flooding in Dashtyari and Sarbaz has many impacts. It damages property and endangers the lives of humans and other species. Rapid water runoff causes soil erosion and concomitant sediment deposition elsewhere (such as further downstream or down a coast). The spawning grounds for fish and other wildlife habitats can become polluted or completely destroyed. Some prolonged high floods can delay traffic in areas which lack elevated roadways. Floods can interfere with drainage and economic use of lands, such as interfering with farming. Structural damage can occur in bridge abutments, bank lines, sewer lines, and other structures within floodways. Waterway navigation and hydroelectric power are often impaired. Financial losses due to floods are typically millions of dollars each year [18].

Therefore recommended control of floods some methods of flood control have been practiced since ancient times. These methods include planting vegetation to retain extra water, terracing hillsides to slow flow downhill, and the construction of floodways (man-made channels to divert floodwater). Other techniques include the construction of levees, dikes, dams, reservoirs or retention ponds to hold extra water during times of flooding [10].

Methods of control in many developing countries, rivers prone to floods are often carefully managed. Defences such as levees, bunds, reservoirs, and weirs are used to prevent rivers from bursting their banks. When these defences fail, emergency measures such as sandbags or portable inflatable tubes are used. Coastal flooding has been suggested addressed in and the Iran with coastal defences, such as sea walls, beach nourishment, and barrier islands [18]. A dike is another method of flood protection. A dike lowers the risk of having floods compared to other methods. It can help prevent damage; however it is better to combine dikes with other flood control methods to reduce the risk of a collapsed dike [22-17].

IX. CONCLUSION

Each mitigation and risk transfer measure reduces the overall risk to some degree, but it is impossible to completely eliminate risk. A flood risk management strategy identifies and implements measures that reduce the overall risk and what remains is the residual risk. In developing the strategy, those responsible judge the costs and benefits of each measure taken and their overall impact in reducing the risk. This text describes measures that can be used to reduce the risk behind levees.

Levees and dikes represent one method of reducing the impacts of flooding on a community or a region. Levees keep the flood waters away from the area behind the levee until the point at which the levee is overtopped or fails and the area behind the levees is inundated and the people and property are affected. The risk to those behind levees is a function of the characteristics of the levee (height, strength), their location, and the mitigation and risk transfer measures and vulnerability reduction actions that they have taken or have been taken on their behalf. Every location within a floodplain, regardless of the presence or absence of a levee and whether or not the levee is accredited, is subject to some level of risk.

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