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A Review of the Flood Hazard and Risk Management in The South Iran Region, Particularly Konarak, Makoran in Balochestan

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ABSTRACT: *Flood preparedness involves building capacities that enable minimizing losses through effective response and recovery. While there are many preparedness assessments at household and community level, very few have been conducted at institutional level. This study assessed the households' perspectives of the preparedness of civil protection institutions in Iran during the 2021 Balochestan flood disaster and identified the capacity building needs of the civil protection institutions. It used a 5-point Likert scale to measure six preparedness indicators: emergency plans, early warning systems, evacuation, resources, disaster knowledge, and relocation camp management. Data came from a cross-sectional survey involving 1456 household-heads who were randomly selected among the affected villagers of Konarak.The findings revealed various gaps in preparedness both at indicator and at variable level. While some indicators showed incipient levels of development in all their variables, others had a combination of low and developed variables. The preparedness elements that critically need immediate attention include the development of emergency plans, evacuation of populations at risk and the prepositioning of resources. However, it is pertinent to mention that civil protection Systems in Iran need to strengthen most of their preparedness elements. As such, this study recommends strengthening preparedness activities in civil protection systems.*

KEYWORDS: Civil protection, flood disaster, indicators, preparedness, variables

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INTRODUCTION

The study was conducted at Kahir and Bir rivers in Konarak district, Kajo river in Kaserkand district, Sarbaz River and Rapch rivers in Chahbar district. Thus location up on which this study concentrates is bounded by the coastline of southern Iran and Western Pakistan, approximately, by the line of latitude 25˚ to the South and the line of longitude 60˚ 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 five rivers locations are not considered sufficiently similar to be pooled together. The Study Area might be classified as "Tropical Triple Season Moderate Climate Zone", which is characterized by single rainfall season from July-September and its moderating influence in temperature. The river flow and rainfall temperature pattern of the area based on the record of data obtained from the Iranian Meteorological and water resources organization department. Iran continues to suffer from natural hazards that threaten to affect the lives and livelihood of its citizens. Due to its unique geo-climatic conditions, Iran is one of the most disaster prone countries in the world and undergoes natural disasters including floods, earthquakes and drought. A location plan is shown in Figure 1.

Figure 1: The area of study Rivers Kahir, Kajo and Sarbaz.

MATERIALS AND METHODS

The area of the study is near the border of Iran and Pakistan. The study was conducted in three different and the biggest rivers in Balochistan are Kajo, Sarbaz and Kahir. The area is located near the borders of Iran and Pakistan. Thus location up on which this study concentrates is bounded by the mountain 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 [1, 22].

Data for in this paper has been obtained from the Water Resources Department of the Islamic Republic of Iran Meteorological Organisation (IRIMO) and relates to the Province of Sistan and Balochestan. It is noted that there is also a neighbouring Province of Balochestan to the west in Pakistan. The climate of the region varies from subtropical arid and semi-arid to temperate sub-humid in the plains of Sistan and Balochestan. The river discharge rate of flow data studied in this paper comes from the southern part of the region including the port of Chahbar [1]. The study was conducted at Kajo River in Kasergand District, Kahir River in Konarak District and Sarbaz River in Rask and Bahokalat. The analysis is based on a multi-sites analysis approach, since the three rivers locations are not considered sufficiently similar to be pooled together. The Study Area might be classified as “Tropical Triple Season Moderate Climate Zone”, which is characterized by single rainfall season from July-September and its moderating influence in temperature [21]. Therefore, flash flood disasters occurred in Konarak district on cities on 20/7/ 2021 which is illustrated in figure (2).

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Figure 2: Illustrates human effects on riverine flood risk disasters River Kahir and Kajo Overtopped levee during the flash flood in July 2021

DISCUSSION

Most townships and urban cities in the developing countries of South Asian are now regarded as popular flood risk areas [1]. Similarly, this is also being reported for Iran as most of the urban areas in this region are located at flood risk hotspots. Urbanisation in these developing countries and the associated fast growing of people living in cities have led to an increase of unplanned and uncontrolled land development activities [2-3]. These activities particularly involved flood-plains in the cities can potentially increase the flood risk to life and damage to property [4 -5]. Due to the rapidly unplanned urbanization, particularly the cities in South Asian and Iran have experienced the equivalent increases in the number of fatalities related to floods. Accordingly, this has been identified as one of the biggest challenges for flood risk management and mitigation in the cities of these developing countries [6-7].

The conventional approach to mitigate flood has primarily involved a structural approach to modify flood characteristics. Whilst structural mitigation measures can reduce flood levels and extents, without adequate floodplain planning, the benefit from the structural works is lost due to increased flooding from unplanned development [9]. Based on experiences of the developed countries, there is a need to include flood risk in formulating future development plans to make cities more resilient and sustainable, practically with a set of guidelines for controlling floodplain development [8-9] .

It is expected that the principles used in the guidelines are incorporated into a national policy for floodplain development, which requires that the authorities to develop clear, robust, and forward-

looking strategic plans [10]. Thus, through effective planning and the best management of floodplain in these cities, the hazard associated with floods can be reduced. The South Asian region has extended history of floods. Countries of this region as shown in Fig. 1, have been countering floods years after years. Floods are of numerous types, namely flash, coastal, riverine, hill torrential, etc., which have been accounted responsible for the erosion of land masses. It further deteriorates the infrastructure, vegetation cover and crops [11, 12]. Besides, the destruction escalate water pollution, produces water borne diseases that ends up in the form of epidemics in the flood affected areas. Loss of human lives, livestock, increased goods prices, insecurity, chaos and outlays of infrastructure's reconstruction are the incremental layers of burden a state has to face once the floods are over. Above that, the resources reserved for disaster management as a quick response to ensure rescue, provide relief and perform immediate recovery activities are also required [13].

Amongst natural hazards, the major financial losses with the most death tolls have been reported during floods [14–16]. Unfortunately, this trend goes worst when it comes to the less developed industrial based and a low human development index country. In spite of dedicating considerable resources, flood mitigation measures in these countries are still not proving to be adequate [1]. Riverine floods provide ample reaction time to evacuate/prepare as it takes too long to develop. On the contrary, flash floods provide little warning as they generate very quickly in the mountainous regions and could be extremely dangerous as it sweep away everything that comes across the downstream [18]. Floods are classified according to their frequency of occurrence in a given time period. For instance, a hundred-year flood is expected to happen only once in every century, theoretically. However, in reality, it means that there is 1% chance that such a flood would occur in any given year. Unfortunately, due to global climatic changes, such floods are occurring regularly at higher rates [19, 20]. Herein an investigation was carried to identify various weaknesses relating to existing flood control measures in the countries situated in South Asia. Further, a detailed overview has been presented, highlighting Iran climate characteristics and its sensitivity toward floods. Despite deploying major institutional support and financial resources, the flood management practices are still not being adequately optimized. For instance, the recent example of 2010 floods in Iran concerns over the reliability of the arrangements taken by the flood management authorities.

Floods in South Iran

Despite the risk of periodic flooding, encroachment on flood plains are always sited for the sake of settlement [21]. Encroachment of flood plains not only causes potential risk to the human life and damages the infrastructure but it also keeps the impervious urban floodplain inundated for a

longer span even after the flooding event is over [6]. An unparalleled transition from rural to urban living has been experienced by the world according to the World Urbanization Prospects. By 1997, almost one third of the world's population lived in the cities. The ratio has now increased to almost 50%. By 2050, it is perceived that this ratio will exceed by two third of the population. The rapid rise is expected to take place in the developing countries and the continents, namely Asia and Africa would be fastest urbanizing regions. Currently, the urban population is 40% in Africa and 48% in Asia which is expected to project by 56% and 64%, respectively [19].

Iran flood context

The climate of Balochestan being hot and dry has witnessed significant variations in the last few years. This leads to caustic floods in the major rivers and their streams. On the other hand, the land sliding forms temporary natural dams which upon subsequent collapse generates exceptionally high flows in the major rivers that results in floods generation [19]. Floods in Iran usually occur during the months of July–October. Therefore, the monsoon crops which are the domesticated plants like Wheat, Tomato, Onion, Water melon etc that are cultivated and harvested get damaged. The crops that are sown in the winter season at times are also affected because of the flooded lands that takes too long to dry. The flood water that spills over the high bank of rivers turns back to the main river channel in the upper part of the Kahir River, whereas in the lower part of Balochestan (Iran), the Kahir River flows at ridge thus embankments are provided along both the river sides. However, the flooding scenario goes worst because the flood water that breaches the embankment does not return to the main channel and inundate the lands which not only affects the standing crop but the communities as well [19] . Restoration works of the Barrages based on the 100 years return period has been initiated by the Sistan and Balochestan Authorities due to embankments breaching. The Kahir Dam construction, rehabilitation of Kahir Barrage at River Kahir, Nikshar and Bent, respectively have been completed. On the other hand, remodelling work of Nikshar and Fanooj Barrage is underway, whereas the rehabilitation work on Lashar Barrage is also in progress. Furthermore, once the detailed designing of Iranshar Barrage is complete, its rehabilitation work would then start [19].

Flood management and mitigation measures

The studs, spurs, flood protection embankments and advanced flood-forecasting techniques are some of the approaches used to manage and mitigate flood impacts in Iran. The flood management measures are being practiced through an integrated approach since the establishment of Federal Flood Commission in 1998. The provincial agencies are responsible to

execute protection works, whereas the federal government deals with the control of funds while ensuring timely decisions [1, 55, 56].

Structural measures

Structural measures are administered by the government. Such measures are employed at a large scale which includes building embankments, construction of spurs, gabion wall, dikes, floodwalls, diversion structures, by-pass structures and floodwaters channelization [57]. Over-bank flooding is usually tackled by constructing embankments, whereas to counter land erosion, spurs are usually built. To mitigate over-bank flooding, approximately 2740 km of embankments have been built alongside the major rivers and their streams. On the other hand, more than 1375 spurs have been built to ensure embankment's protection. Similarly, to protect irrigation networks, head works, villages and towns, protection bunds have been built. Further, to avoid unwanted breach, controlled breaching of embankments is also practiced [1].

Non-structural measures

Being a riparian country, the flood management and mitigations options in Iran are limited and complicated. Therefore, the emphases is mainly on the precise and early warning system. For forecasting floods, Flood Forecasting Division of Iran Meteorological Department plays the main responsibility, whereas the Water and Power Development Authority (WAPDA) also adds to it. A real time VHF telemetry system to forecast early flood warning was first introduced in 2001. The system was used to collect the hydrological data from 24 rain and 16 river gauges, respectively [58]. Till date, flood- zoning consideration doesn't exist in Iran. Under FPSP-II, flood risk mapping for the main river was initiated and the hazard maps for 5 years and 50-years return periods have been compiled. In the forthcoming NPFP, valuation of these maps is also planned, whereas legislation and interpretation regarding flood zoning will be carried out in future. Further, to in- form general public, the polar orbiting meteorological satellites issues daily satellite cloud images which are then shared by the Iran Meteorological Department on their website. Similarly, cyclone detection radar (donated by Japan) is used to monitor tropical cyclones [1].

Legal framework

Since partition, conflicts over the water distribution rights of Indus Basin have been created 2005 between Iran and Afganistan. This issue was addressed with a temporary "Standstill agreement", the "Inter-Dominion Accord 1964"and the "River Water Treaty" which was endorsed through the help of World Bank in 1960. According to this treaty, the use of three western rivers, namely Amoon, Kajaki and Zabol along with their tributaries were given to Iran, whereas the use of three eastern rivers, namely Mashkid, Taftan and Mirjava along with their tributaries were given to Iran [1, 59].

Institutional arrangements

To manage the flood management activities, many provincial and federal institutes are directly and indirectly involved depending on the support and services required. For instance, in Iran the institutes are categorized into risk-managing and crisis-managing institutes.

Risk-managing institutes

The concerned federal agencies or the provincial irrigation and drainage authorities prepare the flood protection schemes which are then studied and sanctioned by the FFC either on urgent basis or in group of projects. The provincial irrigation and drainage authorities look after the design, construction and complete maintenance of river training and flood protection works. Further, it provides the discharge measurement of drains, canals and rivers for forecasting floods. Moreover, the flood emergency plan are also prepared by this department [1]. A flood risk assessment map has been shown in Fig. 1-2 [60].

In view of the above findings, this study makes four policy recommendations. First, the civil protection authorities should invest in disaster preparedness in the same way they put resources for disaster response. This means that the thrust of their activities should be on proactive rather than reactive measures. Doing sohas many benefits: it enhances disaster resilience, saves life and property, and provides long-term financial returns that can offset public expenditure on disaster response and recovery. Second, communities at risk should be engaged when developing, testing and simulating emergency plans. This can be the starting point in preparing for disasters as it may trigger the development of evacuation procedures, routes, relocation shelters and the prepositioning of resources. Third, the civil protection organisation should strengthen its capacity for evacuation. Although this can be costly in terms of time, money and other resources, evacuation remains a risk-averse decision that minimises fatalities. Strengthening the capacity for evacuation will also improve other weaknesses of the civil protection institution. This is because preparing for evacuation will include other processes of warning the people at risk, determining evacuation routes and establishing safe havens [7].

Finally, early warnings are needed whenever a group of people is faced with a hazard. Such warnings can have benefits that exceed their costs: they can save life and property, enhance community resilience, strengthen disaster knowledge and engage other institutions across sectors. In fact, there is no reason to invest in DRR knowledge, meteorological and hydrological monitoring services if no warning would be given to at risk communities.

Crisis-managing institutes

Crisis management is controlled by the administrative entities. At provincial level, the relief department arranges survey and ensures the maintenance of flood protection bunds prior to the flooding season. It further set up the flood warning centers at district and union level and

functions through the coordination of other government departments. At the federal level, the emergency relief cell deals with the assessment and planning of relief requirements for major disasters. Addition- ally, the Army provides help to the civil authorities to perform the rescue operations during and after floods [61]. During floods, Army sets up flood emergency cells at each corps headquarters, however the provincial government is responsible to provide the supporting equipment to the Army, namely life jackets, boats, vehicles, tents, etc [1].

Natural and Physical Environment of Makoran

Therefore, in this regards as well as so in the Makoran, flood study could be said with location of Sarbaz and Kajo rivers the upstream parts of the rivers flow through heavily mountainous and hilly regions while the remainder of rivers flows through broad, flat valleys. The upland, villages landscapes are dominated by a mixed area, which areas comprised of Nannorrhops (Mazari palm trees) and tamarixes etc [14]. Also the upstream half of the rivers below Pishin and Zirdan flood control dams are dominated by coarse gravels, with areas of fines and larger sands also present to a lesser degree. The downstream half of both rivers below the dams are predominately small to medium sized sand or cobbles. Therefore, interspersed with areas of fine sediment and larger sands and boulders, the coarse gravels are also present in those particular areas. Furthermore, the historic water quality problems stemmed from drainage and rainfall runoff, which also caused low dissolved oxygen, elevated water temperatures and high turbidity. Low summer flows have also caused some problems in the river but these are primarily a natural function arising from the small drainage size. Although, there are many reaches existed, so the majority of reaches are located of the side of the rivers. However urban development along these rivers in Makoran is important feature, providing crucial life history for flood control and also for such as rearing and holding habitat for fish, and over wintering habitat for migrating waterfowl. The existing fill and spill for flood control dams operations result in seasonal fluctuations surface elevations [16].

Flood Preparedness and Its Measurement

The study assessed the households' perspectives of the flood preparedness of civil protection institutions in Iran and identified the capacity building needs of the civil protection institutions in Iran. It used six context-specific indicators that were measured at variable level. The findings revealed different gaps in preparedness at both indicator and variable levels. While some indicators showed incipient levels of development across all their variables, others had a combination of low and developed variables. The measurement of the variables on a Likert scale enhanced the accuracy of the indicators. This approach also revealed some important areas that needed capacity building. Such areas include development of tested and updated emergency plans; evacuation procedures, routes and shelters; and prepositioning of resources (funds including cash transfers, vehicles, equipment, food, and NFIs).

This shows that the assessment of flood preparedness need to go beyond the broad indicators to include a series of variables. This is because the broad indicators tend to mask the relative importance of some variables that constitute the specific flood preparedness [6, 19]. Therefore, variables in need of further strengthening include issuing flood protection and risk management in arid areas of Balochestan by dykes and embankemt and other hydraulics structures in different rivers of corresponding areas of Makoran or part of Balochestan as well.

CONCLUSIONS

Floods have been reported one of the major disasters in South Asia that has exposed many communities to risk. Among the major cause of flood occurrence involves breaching, overtopping and in some cases structural failure of the dams. Keeping in view the proximity of flood occurrence, the land use practices need to be enhanced. Further, to ensure effective flood warning, the transmission networks to record the flood related data need to be strengthened. To dissipate advanced real time data, there is a scope of improvement on various aspect of flood hydrology; flood volume, rainfall and runoff estimation. It has been further observed that the major reservoirs of this region are not ready to take the peak discharges during the flood seasons. Therefore, there is an urgent need to combat urban floods. For instance, the incident of flooding in Balochestan (2010), and the floods that shattered Iran in (2021) are the recent examples. Further, the measures to mitigate the impact of flash floods are unsatisfactory. The devastating flash flood in Kahir and Konarak (2021) and in Tiss Chabahar (2021) are the recent examples. Moreover, during prolonged monsoon and storm surges, concurrent swelling of major rivers along the cities located nearby the coastline have been reported in the South Iran Region. The high concentration of settlements along the coastlines also raise question on the coastal management plans. Thus, capacity building initiatives and the need to intensify the institutional strengthening in the region are required.

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