Original Research Article

Causes and Impacts of Drought and Flood events in Haryana, India: A Regional Perspective

Abstract

Droughts and floods are inherent in our country and across the world, though they often occur in successive years, causing severe losses to agriculture and human life. They are the most complex disasters affecting more people than any other disaster. A recent IPCC (20222) report indicates an increase in the frequency and severity of droughts and floods over India during the twenty-first century. Therefore, flood and drought assessments are necessary to understand future planning and enhance decision-making. Haryana majorly depends on groundwater and rainfall for its agriculture and domestic water needs. In this paper, an attempt has been made to assess different aspects of drought and floods, including their: causes, and impacts. The paper also presents a set of recommendable measures to avoid potential loss and cope with the impacts of drought and flood in the Haryana. The study is based on secondary data; data has been taken from the statistical abstract of Haryana and the Indian Meteorological Department. Historical data on rainfall, droughts, and floods have been analyzed and assessed for interpretation.

Keywords*: Haryana, Drought, Flood, Monsoon, Water*

1. Introduction

Water is an essential substance to sustain life on the earth. All flora and fauna on the earth must have water to survive on this planet. If there would be no water**,** there shall be no life on earth. However, about 74% of natural hazards were water-related [1]. A report published by the World Bank in 2017 asserted that India might experience a loss of 6% of GDP by 2050 due to the water crisis. Droughts and floods are major components of natural hazards and are related to the Hydroclimatic crisis. Droughts are mainly categorized into four major classes: (a) meteorological drought, as a deficit in precipitation; (b) hydrological drought, as a deficit in stream flow, groundwater level, or water storage; (c) agricultural drought when the moisture level in soils is insufficient to maintain average crop yields; and (d) Socioeconomic drought, incorporates demand of the water supply and goods and services with the three types as mentioned above of drought [2]. A flood is a temporary inundation of a large region resulting from the overflow of land areas due to heavy rains, cyclones, tsunamis, temporary backwater effects in sewers and local drainage channels, creation of unsanitary conditions, deposition of materials in stream channels during flood recession, the rise of groundwater coincident with increased stream flow, and other geo-environmental influences [3]. In northern plains, these floods are triggered by intense or long-duration rainfall. It has been reported that approximately 8 million hectares of the land surface area are overripe by floods over India [4].

In the Indian Subcontinent, the spatial distribution of floods and droughts is mainly associated with monsoon variability **[5].** The Indian summer monsoon (ISM) is the dominant seasonal mode of wind circulation in the tropics. Its performance from June to September decides the fate of agricultural productivity in India, which in turn decides the growth of the economy [6]. India's food grain production, especially paddy rice, greatly depends on the life-giving rains of the monsoon. The poor simulation or the failure to predict ISM rainfall can create a colossal loss of tropical crops such as rice, cotton, and jute [7]. By the ISM's failure, severe drought may take place on deficit rainfall [8]

In 1972, India suffered a colossal loss of about one-third of its food crop, on account of a very poor monsoon. Similar crop shortages caused by the failure of the monsoon rains in recent decades occurred in 1965-66, 1974, 1979, 1982, and 1987. Sometimes the behavior of the monsoon is so erratic that heavy rains cause disastrous floods. In 1972, while most of the country suffered severe drought, serious flooding took place in Uttar Pradesh, Bihar, and West Bengal [9]. Even small variability in rainfall across the Indian states significantly impacts the socioeconomic conditions of people who largely depend on agriculture [6-7, 10]. IPCC also reported that the severity of floods and droughts might deteriorate under GHG emissions. The interannual and spatial variability are the most challenging problems with the ISM. The inadequate and irregular rainfall in many parts of Haryana is one of the key limitations to agricultural and other socioeconomic activities in the state.

In This paper, an attempt has been made to assess different aspects of drought and floods, including their: causes, and impacts. The paper also presents a set of recommendable measures to avoid potential loss and cope with the impacts of drought and flood in the Haryana. Here, I also highlighted the impact of excess and deficit rainfall during the summer monsoon season in Haryana. The results revealed that floods and droughts in the past coincided with the excess and deficit of the average monsoon rainfall.

2. Physiography of Haryana

Haryana means the "Abode of God," and is situated in the northwestern part of India (latitude 2 7 °3 9 ' to 30°55' N and longitude 74°27' to 77°36'E). Haryana has two major photographic regions, i.e., plain and hills: alluvial plain covered by the 'Bangar and Khaddar' and the northeast lower Siwalik Hills and southwestern remnants of Aravali mountains. The State has three distinct seasons, viz. winter (November–March), summer (April–June), and Rainy season (July–October). The most rainfall occurs during the monsoon season (July–September), with occasional showers during December–January due to western disturbances. The range of precipitation in this region varied between 160-751 mm (IMD), i.e., lowest in the southern part and highest in the northern region. Rainfall During the monsoon month in Delhi, adjacent union territory to Haryana powered by the Bay of Bengal (BOB) and Arabian Sea branch of ISM [11].

3. Methodology

The criterion used in this study is taken from [12-13]. Seasonal rainfall for the State of Haryana was plotted for June to September. Rainfall (R) of each year has been classified into three categories viz. Excess, Deficit, and Normal as.

1 Excess: $R \geq M$ +SD

2 Deficit: $R \leq M - SD$

3 Normal: $M - SD < R < M + SD$

In this study, the loss of economy study during the month of excess and deficit years is plotted . We also used historical data from validated government datasheets from other sources like India Meteorological Department, Haryana State Disaster Management Authority, and Press Information Bureau.

4. Result and Discussion

Haryana is marked under the water-stressed states under the Atal Bhujal Yojana (ATAL JAL), a Central Sector Scheme for facilitating sustainable groundwater management. Haryana agriculture is still heavily dependent on monsoon rainfall and groundwater formation. The water needs in the agricultural sector will be very high, as several thousand tons of water are needed to produce each metric ton of food grain. Furthermore, about 80% of the State's population is dependent directly and indirectly on agricultural activity (https://farmech.dac.gov.in/). Almost ~25 percent of its gross cropped area (GCA) is rain-fed. Even the area irrigated through canals, tanks, watersheds, and groundwater is impacted when low rainfall. Reservoir levels and groundwater levels dip during drought years. A slight deviation in the summer season rainfall can lead to flood and drought conditions in this northern State. This paper emphasizes droughts and flooding years coincident with the deficit and excess rainfall year . Our observation indicates the cause of the droughts and floods in the Haryana during 1987, 2002, and 1980, 1995 follows the monsoonal intraseasonal variability .

In the year 1987, drought was caused by the deficit monsoon rainfall. During 1987, drought-affected approximately 6,351 villages with more than 1.4 million ha of land, and 5 million livestock [14]. Drought conditions also imposed challenges to the availability of drinking water and industrial requirement. The Indian government allotted 3.70 crores of assistance in 1987 for drinking water. A study in Haryana [14] has shown that droughts result in unstable agricultural production, more in Kharif crops and less in Rabi crops. Kharif crops were severely affected during this drought, and sowing was done in only 40% of the area of Haryana [14]. Similarly, Haryana declared a drought in 2002 when the rainfall deficit was 51%. In 19 of its 21 districts, it was below 50% [15]. In 2002 the ISM was perceived to be comparable to the 1987 drought [15]. Among the major disasters in the Haryana sub-region, river floods are the most hazardous as they cause heavy damage to the socioeconomic structure. The cause of flood is primarily attributed to peculiarities of the rainfall in the State. Floods create colossal damage to the standing crop, and loss of life and pose critical challenges to the rural population. A slight deviation in the normal rainfall might cause flooding in the alluvial plain of the Haryana due to a weak drainage system, unplanned city, Ephemeral River flooding, and a saucer type of topographic depression in the central part of the State. Historically Haryana witnessed flood in 1977, 1978, 1980, 1983, 1988, 1999, 1995, 1996, 2000, and 2010. Out of these two major known flood disasters, mishaps took place in the sub-region in 1980 and 1995, respectively. This flood claimed more than 40 lives all over Haryana and damaged ~55000 houses. Rohtak faced floods in 1960, 1980, 1987and 1995. The 1995 flood faced by the city was devastating in terms of socio-economic losses. The town suffered a colossal financial loss, i.e., Rs. 2,000 crore with approximately 55% area being submerged under water. 83% of the total villages were flood-

affected, out of which 34% were severely affected and 49% were moderately affected (Flood Control Department, Rohtak). Additionally city witnessed loss of clean water and damage of local ecosystem.

A recent study by Rani, 2019 described the changes in the land use pattern over the period from 1966-69, 1990-93, and 2010-13. The study has documented a sharp decline in the proportion of forest cover in Haryana from 1966 to 1969 [17]). The significant increase in the proportion of area under put to non-agricultural uses has been increased due to urbanization and industrialization. The decrease in the forest cover and agriculture land in the Haryana makes it more susceptible to floods and droughts. Because, forests can soak up excess rainwater, preventing run-offs and damage from flooding. By releasing water in the dry season, forests can also help provide clean water and mitigate the effects of droughts. However, an increase in imperious surface of streets, rooftops, parking lots, multiple highway and concrete waste disposal site cause fast drainage by concrete storm drains and sewers, very little supply to streams and increasing flooding.

I conclude that urban planners and policymakers need to institutionalize transparency and cross-sectoral integration in multi-sector partnerships, to mitigate droughts and floods impact in forthcoming decades and recommendable measures to avoid potential loss and to cope with the impacts of drought and flood in the Haryana. Furthermore, the monsoon is constantly changing and shifting, affecting the size and frequency of floods and droughts in the region. As a result, for monsoon modelling and prediction, the current synthesis on monsoon variability, as well as annual variation in contemporary and historical archives, specifically on regional basis is important.

5. Conclusion

This study indicates that the primary reasons for the flooding and drought in Haryana are excess and deficit rainfall during the monsoon and an increase in urbanization. Additionally, the study's findings reveal a significant impact of drought and flood on agricultural production in Haryana. We proposed that skillful anticipation of the monsoon on regional basis can mitigate the colossal loss of crops and livestock in agricultural states like Haryana. Mapping of flood-prone areas, management of weak drainage systems, and better planning of the new city can also help mitigate the consequences of flooding and drought due to urbanization. Awareness of the IMD forecasting result before the monsoon onset between farmers can also help plan the crops. The forecast operation of ISM suggested here to be made to the district's scale for better results and planning and to reduce threat to life and property across rural and urban areas.

6. REFERENCES

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