



(REVIEW ARTICLE)



## Reviewing the use of technology to manage floods in India

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### Abstract

The present article is a review of existing technology that can help predict as well as manage floods in India. Since some of the major metropolitan cities in the country have been regularly experiencing floods over the past few decades, this not only puts property at risk, but also increases the probability of loss of life due to the floods. Today, novel techniques of predicting floods have replaced the traditional ones. One such technology is the use of artificial intelligence. This has been highlighted in the article as well. This does not mean that traditional methods for predicting and preventing floods have become outdated. It simply means that newer technology can help strengthen existing ones and aid in saving lives. The information that can be captured by the Artificial Intelligence (AI) can benefit the community in leveraging and building the community resources. There is a need to give equal importance to rehabilitation of affected people post the disaster. The authors have also highlighted how modern-day technology can help provide human services such as counselling to survivors during and after floods.

**Keywords:** Technology; Floods; India; Artificial intelligence; Remote sensing

### 1. Introduction

The death and destruction caused by floods around the world is well known [1]. This is specifically true for developing countries such as India which was one of the worst affected countries during the pandemic, which led to a significant impact on health care workers [2] as well as the education system, which had to be urgently shifted to the online realm [3]. Floods in India have been a regular occurrence since time immemorial. However, factors such as climate change, rapid and uncontrolled urbanisation, apart from a population explosion have exacerbated the situation [4]. In the past few years, several floods have ravaged major cities such as Mumbai and Chennai [5], apart from many smaller cities and towns as well. In times of such crisis, there is a need to develop as well as deploy technology that can predict the floods and protect the most vulnerable sections of society such as children, who are already facing many challenges such as trafficking [6] and the differently abled, who need special care and support [7]. Over the years, there has been a significant amount of effort made to improve the technology that can assist the scientific community as well as policy makers in predicting floods around the world [8]. However, not all of them are affordable nor useful in specific circumstances. One of the major requirements for developing countries is for the technology to be affordable as their national income does not allow them to overspend. India is one such country that needs to resort to certain technological and mathematical models in predicting floods [9]. The aim of the present paper is to review existing technology that can be used to successfully predict and manage floods in India.

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## 2. Some Existing Technology to Predict Floods

Predicting floods is a multivariate problem. This means that as a scientist, one has to take several variables into account such as the amount of rainfall, the intensity of the storm or cyclone, and the topography of the location where the storm is likely to hit and cause a flood. Ever since the beginning of the machine learning era, there have been sincere efforts made on the part of scientists in predicting floods. In an article by [10], the authors have reviewed all the major machine learning techniques/models that can help predict floods. The researchers concluded that among all the existing techniques, data decomposition, hybridization, algorithm ensemble, and model optimization were found to be the most effective ways of predicting floods [10]. The other major technique is the hydrological modelling that is based on four different types of regression including the boosted decision tree regression [11]. In another effort, the authors of a paper carried out a comparative analysis of stepwise multiple linear regression and artificial neural network to identify how successful the models were in predicting the floods [11]. The authors discovered that although both the stepwise multiple regression model as well as the artificial neural network model were able to accurately predict the floods, the artificial neural network model was better at the prediction [11]. These point to the fact that artificial neural network models might be superior to the traditional regression models in not only predicting floods, but possibly other disasters of a similar nature. These studies are a testament to the extent to which research in the realm of neural networking model has grown. Most studies that use advanced models and techniques are used for a for-profit motive. However, the use of these models in predicting dangerous disasters such as floods and in saving the lives of millions is a welcome change. Apart from the previously mentioned studies, there has been significant advancement in certain remote sensing technology that can help predict floods and offer an opportunity for governments to provide early warning to citizens so that they can be evacuated in time. In one article, the authors have reviewed the existing remote sensing methods in predicting floods and have classified the methods into three categories/types- multispectral, radar, and light detection and ranging [12]. The authors note that over the years there has been a surge in the number of studies that are aimed at using a combination of remote sensing as well as artificial intelligence models in predicting floods [12]. A careful review of the existing literature reveals that there is a slow shift from using traditional methods of prediction to more complex and artificial intelligence powered methods to predict floods. This is an aspect which India also needs to take note of because India has continuously been experiencing the destruction caused by floods. Applications such as GIS and remote sensing tools have been used to detect any disaster well in advance and support policy formation [13].

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## 3. On the destruction caused by floods

India is a subcontinent with several rivers that have the right to be protected and preserved [14]. However, due to a rapidly increasing population [15] that is causing a threat to the environment by placing increased pressure on the existing natural resources such as water, the country has seen several water disputes over the years [16]. All of this is a reflection of the rapid and somewhat uncontrolled urbanisation that has been sweeping the nation [17] and it is precisely this rapid urbanisation that has now increased the vulnerability of the major metropolitan cities in the country to floods, along with several governance issues as well [18]. Some of the major infrastructural damages caused to cities by floods are the roads, powerlines, and communication networks, although the loss of communication networks is often restored quickly after a loss. In the one recent flood that hit Tamil Nadu, the residents and the government used social media networks and chat applications to network with one another and provide relief to those who needed it the most [1]. These are, however, only efforts that can help minimise the loss. When a flood hits a major city, it is bound to cause financial loss and even the loss of life. India needs an integrated technological approach to help predict floods and to reduce the level of vulnerability of major cities [19]. While the media has always carried out its responsibility of reporting the impact of disasters, its focus is largely on metropolitan cities and not in the rural and local regions of the country which are also vulnerable [20]. Apart from the physical damage caused by floods, there are certain psychological effects of such disasters as well [21]. People who experience the death of a loved one or even closely witness death and destruction of those around them could develop psychological problems such as post-traumatic stress disorder or PTSD. The next question is- how can technology help in not only predicting, but in alleviating the pain of those who have been impacted.

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## 4. Role of Technology during Floods

During floods, as mentioned in the previous section, social media can be a great tool to share the ground reality and inform the friends and relatives of those affected. Social media networks are easily accessible to a vast majority of Indians today due to the vastly improved mobile network technology [22]. In the initial years of the growth and development of mobile technology in India, social media was the primary way to reach out to the affected population. Today, one can witness the emergence of smartphone applications that can offer mental health support to people experiencing disorders such as depression [23]. Such mobile applications can be of great use for the survivors of floods.

In India, there is a stigma attached to mental illness [24]. This acts as a barrier for a large number of people from accessing mental health services in the country. This is why the development of mobile applications to offer support and initial screening options for those who need mental health support after experiencing a disaster is important and the need of the hour. Disasters such as floods not only affect the victims themselves, but also their families who might be living far away. This is primarily due to the fact that family members and relatives who are far away might be constantly stressed about the safety of their loved ones trapped in the floods. This is where the use of mobile technology for making video calls and for sending multimedia such as photos and videos, proves to be useful. Smartphone technology can also help supply information to media outlets who can then supply this information coupled with videos and photos to the general public, resulting in almost real time updates on floods. Media outlets refer to such members of the public as citizen journalists [25]. This new dimension of journalism is clearly powered by innovation in smartphone and communications technology. Apart from accurately predicting floods and helping manage the rescue and relief operations during the disaster, technology can also help in rehabilitating those who have been affected by disasters.

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## 5. Rehabilitation of survivors of floods

The survivors of floods often experience a lot of economic loss including the loss of their homes [26]. This necessitates the establishment of relief camps and re-building of the destroyed homes. This is also a time for reviewing the topography and location where the house was initially built. The use of geospatial technology can help identify the level of vulnerability of an area to disasters such as floods [27]. Relief camps must also be established in places that are less likely to be affected by floods. In such scenarios, the disaster management team, which is often headed by the government, must collaborate with civil society and scientists to identify and establish safe relief camps. On the whole, the use of technology in the rehabilitation process can not only save lives in the present, but can also reduce the level of damage a possible flood could reduce the vulnerability of the people to disasters such as floods. In areas where medical teams are unable to immediately reach after a disaster has struck, telephonic counselling can be provided to victims who are trapped and are unable to escape [28]. These are some of the means through which technology can be used to support and rehabilitate those who are trapped during floods.

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## 6. Conclusion

This paper delves comprehensively into the critical issue of flood prediction and management in India, recognizing the urgency for affordable and effective solutions given the challenges of climate change, rapid urbanization, and a burgeoning population. The study emphasizes the importance of advanced models, such as artificial neural networks and remote sensing methods, in predicting floods, offering a viable path for India's disaster preparedness.

The role of technology extends beyond prediction to critical phases during floods. Social media platforms and mobile applications emerge as powerful tools, aiding in communication, mental health support, and real-time updates. Furthermore, technology plays a pivotal role in the rehabilitation process, leveraging geospatial technology for identifying safe relief camps and offering telephonic counselling in hard-to-reach areas.

India, grappling with the increasing frequency of floods and their devastating consequences, recognizes the integration of advanced technological solutions as not just a necessity but a lifeline. Policymakers and stakeholders must embrace these innovations to ensure a holistic approach to flood management, anticipating disasters and minimising their impact on vulnerable communities. The convergence of affordable, cutting-edge technology with proactive policy measures stands as the key to fostering a resilient and well-prepared India in the face of future floods.

The paper provides a nuanced understanding of the multifaceted challenges posed by floods, from the environmental threats due to population pressure to the vulnerability of major metropolitan cities. The devastating impact on infrastructure and the psychological effects on individuals underscore the need for an integrated technological approach in predicting floods and reducing the level of vulnerability. The discussion on the role of technology during floods emphasises its varied applications, including mental health support and communication through social media platforms and mobile applications.

The rehabilitation of flood survivors involves economic loss, the establishment of relief camps, and the rebuilding of destroyed homes. Geospatial technology plays a crucial role in identifying the vulnerability of areas to disasters, aiding in the establishment of safe relief camps. Additionally, telephonic counselling becomes a valuable resource in areas where immediate medical teams are unable to reach.

In essence, the paper provides a comprehensive understanding of the complex interplay between technology and flood management in India, addressing not only prediction but also critical aspects during and after floods. The integration of advanced technological solutions with proactive policy measures emerges as the linchpin for a resilient and prepared India in the face of future floods

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## Compliance with ethical standards

### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

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