The Role of Big Data and Mining Technology in Strengthening Flood Resilience and Adaptive Capacity in India

Introduction

Floods are one of the most destructive natural disasters in the world, posing a significant challenge to Indian society, economy, and ecosystems. （Saharia et al.， 2021）With the increasing influence of climate change, the frequency and impact of flood disasters in India are also on the rise. With the advancement of modern computer technology, cutting-edge science and technology are gradually being applied to flood control issues. Big data technology is a typical example, as it integrates large-scale, diverse datasets to uncover their underlying patterns and regularities.

This research aims to explore the role of big data and mining technologies in enhancing flood resilience and adaptive capacity in India , also their potential in flood management。

Source evaluation

The article by Mohanty et al. is a reliable source, published within the last five years, ensuring timeliness. It integrates a significant amount of accurate data, offering a practical study on flood management in India, closely related to my research. It originates from ScienceDirect, a leading global scientific database, enhancing its credibility.

The article by Nagendra et al. is another reliable source is an article published within the last two years. Authors from reputable engineering universities in Europe and Australia contribute, bringing expertise in computer science. This study focuses on satellite big data analysis, examining its application during the 2018 floods in Kerala, aligning well with my article's theme.

Saharia &Manabendra‘s article is deemed reliable, being cited by other reputable sources, and published within the last three years. It offers a comprehensive overview of flood management methods and data analysis results, introducing geographic spatial datasets, highly relevant to my article.

Causes

The severe flooding in India is attributed to a complex and diverse array of factors.

1.Complex natural factors

Mohanty et al. indicated in their research that the primary causes of flooding in India include sustained monsoon rains, low-lying terrain with low carrying capacity, among others. Concurrently, rapid urbanization has also emerged as a significant direct catalyst for severe "urban inundation" in India.

The research by Nagendra et al. focused on the sudden nature of flood disasters. Due to the unpredictable occurrence of disasters, it becomes challenging to carry out pre-disaster preparedness and post-disaster relief efforts.

2.Weak technical capabilities:
Additionally, Nagendra et al. noted that under the current application of big data technology, the available information in disaster-affected areas suffers from rigidity and inaccuracy, echoing the sudden nature of such disasters. Furthermore, Mohanty et al. pointed out that the existing flood forecasting systems have limitations. Whether in terms of pre-disaster warnings or post-disaster relief efforts, India faces numerous technological gaps.
These findings highlight the urgent need for effective measures to address this issue.

Effects

According to a report from the Central Water Commission (CWC), during the period from 1953 to 2016, India recorded the highest number of fatalities due to floods among Asian countries, exceeding 100,000 deaths. Concurrently, floods have had a counteractive effect on economic liquidity: as indicated in the study, approximately 16% of the vulnerable water-supply areas in India are affected each year, resulting in losses exceeding approximately $21.6 billion, with a continuous upward trend.（Nanditha et al.,2021）
The impact of floods on India is multifaceted and enduring. Therefore, comprehensive flood management is crucial to ensure the sustainable development and stability of society.

Solution

To mitigate the impact of flood disasters, India has introduced both structural and non-structural intervention measures.

1. Structural measures
Structural measures aim to physically control floods through engineering and architectural means.This includes:
1.1 Flood embankments:Through physical defenses, floods are confined to specific areas to prevent inundation of low-lying areas.
1.2 River channel improvements:Undertaking measures such as dredging, widening, and deepening of river channels to enhance drainage capacity.
1.3 Reservoir construction:Implementing flood storage measures to mitigate the formation rate of flood peaks.(Nanditha et al.,2021)

2. Non-structural intervention measures
However, structural systems often cannot fully withstand the catastrophic destruction caused by floods, highlighting the importance of introducing non-structural intervention measures, which include:
2.1 Warning systems:Predicting and alerting the occurrence of floods by monitoring meteorological and hydrological data, coupled with Geographic Information System (GIS) technology.
2.2 Rescue positioning systems:Assisting rescue personnel in accurately and swiftly pinpointing the location of disaster-stricken areas and guiding them to efficiently carry out rescue operations by integrating spatial geographical systems.（Nanditha et al.,2021）
Non-structural intervention measures, through the deployment of Information and Communication Technology (ICT) infrastructure, integrate satellite data and other relevant

data sources such as census data. By combining these with big data, they provide accurate and high-resolution weather forecasts as well as real-time information and communication for rescue teams and affected populations. This integration enhances the effectiveness and efficiency of disaster prevention and management responses.(Nagendra et al.,2022)

Future action

Given the significance of big data technology in non-structural intervention measures, India should further advance the integration of Information and Communication Technology (ICT) with big data mining technology by establishing an open data sharing platform to strengthen capacity against flood disasters. We require the following steps:

(1) Clarify the needs and objectives of flood risk management: India faces severe flood issues, complicated by its diverse geographical environment. The exigency of sudden disasters demands high accuracy and timeliness in information provision.

(2) Integrate existing data and technology: Flood management in India involves multiple government departments, and close collaboration with them can facilitate the full utilization of existing resources, integrating data sources into the platform.

(3) Consider network coverage and the digital divide: Addressing the low network coverage in some remote areas of India requires strategic measures, such as establishing offline data storage facilities or employing mobile data transmission technologies.

(4) Establish information sharing and collaboration mechanisms: Facilitate timely sharing of flood risk-related data and information among different departments and stakeholders.

(5) Provide ongoing training and technical support: Continuously update and upgrade the platform based on user feedback and new technological developments, ensuring its sustained effectiveness.

This methods take into account the realities of India's national conditions, and are expected to effectively mitigate flood hazards within five years.

Reference

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