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ROLE OF 5G INTERNET, IOT, GIS, REMOTE SENSING, SATELLITE AND WIRELESS TECHNOLOGIES FOR SMART DISASTER MANAGEMENT: A COMPREHENSIVE REVIEW AND ANALYSIS

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Abstract: The rapid advancement of information and technology has changed human life to such a large extent that we remain vigilant to handle natural disasters, such as floods, earthquakes, tsunamis, etc. This study presents a data-driven review of modern emerging technologies like 5G networks, the Internet of Things, global positioning systems, GIS-based mapping platforms, remote sensing satellite systems, wireless networks, etc. As the system relates to the Sendai Framework, it helps in early warnings in handling emerging disaster management practices. These technologies help government agencies and affected areas to stay connected during disasters; these networks work when normal systems fail to function. The present study highlights that modern technologies help to improve disaster management efficiently, as they give early warnings about disasters, guide the teams to work accordingly, predict the nature of damage, and improve aftermath. Although wireless networks have major challenges like implementation cost, cybersecurity risk, operability, access, and lack of basic knowledge, the Sendai framework ensures smooth functioning and risk reduction in accordance. The present study concludes that synergistic integration of 5G, IoT, Satellite Data, and geospatial tools recommends strategic investment, policy frameworks, and ensures sustainable and equitable use of emerging technologies in the future.

Keywords: Disaster Management, 5G, IoT, GPS, Google Maps, Remote Sensing, Satellite Communication, Wireless Technology

1. INTRODUCTION

Both natural and human-made disasters pose a significant threat to human lives, economies, infrastructure, and transportation modes, making it a major challenge to societies across the world. The disaster happens when the ability of the community to handle a hazard is surpassed, and the management of disasters involves not only reaction but also the evaluation of threats and their elimination (UNDRR, 2023). The analysis of EM-DAT Data Statistics in India of disaster trends occurring in the country between 1980-2024 shows that the number of natural hazards has significantly increased, and the frequency and severity of hazards occurring are largely determined by floods and storms, which are the most frequent and devastating events in the country. The outcome of these disasters has led to massive effects on humans, social, and economic impacts, which highlight the susceptibility of the country to climate-related hazards. The integration of modern technologies like 5G Internet, the Internet of Things (IoT), GPS, Google Maps, Remote Sensing, Satellite communication, and other wireless systems has become essential in enhancing disaster preparedness, response and mitigation systems. According to data, it has been observed that over the last few years, there has been a reduction in the number of deaths and damages to the economy, which shows that there is increased efficiency in the technology-based early warning systems, real-time monitoring and strong infrastructure. With the support of the Disaster Management Act (2005), the Sendai Framework on Disaster Risk Reduction (2015-2030), India is now moving towards a more data-driven and proactive disaster management paradigm, which increases national resilience and sustainability.

In recent years, advanced digital technologies have converged to redefine disaster management paradigms in the world. Remote Sensing (RS), Geographic Information Systems (GIS), Global Positioning Systems (GPS), and satellite communication systems are important tools that generate real-time geospatial intelligence that is crucial in early warning and swift response (Le Cozannet et al., 2020). The emergence of IoT, 5G mobile networks, and wireless communication infrastructures also makes it easy to collect, transmit, and coordinate any data during an emergency (Adeel et al., 2019; Bolla et al., 2025). Similarly, the use of such platforms has democratized access to spatial data, enhanced local preparedness, and situational awareness, such as Google Maps and AI-based analytics (Roche et al., 2013; Sathianarayanan et al., 2024).

Anyhow such technological improvements, literature has certain gaps. Most of the studies usually deal with isolated technologies, including IoT or RS, without delving into their synergy with each other in an integrated disaster management model. Empirical studies are still in their infancy in developing nations such as India, where the scarcity of resources, fragility in infrastructural support, and issues related to governance determine technology uptake. According to (Kucharczyk and Hugenholtz, 2021), researchers do not maintain balance and differentiate between different aspects and togetherness, which has become a hurdle. Herein lies a major gap, insufficiently explored to date, related to how interrelated technologies, including 5G, IoT, GPS, Google Maps, RS, satellites, and wireless networks can be collectively applied to disaster prediction, communication, and resilience in a variety of settings. The study will fill the gap by examining the synergistic nature of emerging communication and spatial technologies in the contemporary disaster management system. It attempts to determine their overall effect on preparedness, mitigation, response, and recovery and emphasizes implementation challenges, policy implications, and future opportunities of developing nations. It can help construct an all-encompassing, technology-induced event of disaster resilience and risk minimization in the digital era.

2. Literature Review

2.1 Fifth Generation (5G)

The 5G mobile network improves disaster response in terms of high-speed connectivity, low latency, and reliability, as well as supporting many connected devices at the same time. It also has the benefit of a simple integration of IoT, AI and UAV technologies to improve situational awareness, decision-making and coordination among emergency responders. Such functions as edge computing and network slicing optimize the management of resources and response even more (Bolla et al., 2025). Under 5G, Device-to-Device (D2D) communication can be used to directly communicate the devices without going through core networks, hence it minimizes latency, and connectivity is still possible even when the base stations have been destroyed or have many users. D2D clustered networks facilitate sharing and coordination of content quickly in the event of an emergency, but distributed control, caching, and delivering content are a challenge, and strong architectures are needed to enable consistent work (Ahmed et al., 2019). Overall, 5G is a conclusive catalyst for an intelligent, data-driven, and resilient disaster management system. Nevertheless, the issue of infrastructure expenses, cybersecurity, and interoperability should be closely addressed.

2.2 Internet of Things (IoT)

The use of the IoT as an integral part of disaster management is becoming more important as it links sensors, devices, and communication networks to allow real-time tracking, reactions, and responses. IoT facilitates a free flow of information between the real and virtual worlds by means of integration of sensing, communication, and smart networking systems (Atzori et al., 2010). The IoT applications enhance readiness, reduce loss and save lives using advanced warning systems of flooding, earthquakes and wildfires. The sensors, drones, and smart infrastructure would increase situational awareness, quick information exchanges, and decision-making in case of an emergency (Leong, 2025).

The experience of such cities as Barcelona, Tokyo and California regions proves that less time, fewer people, and fewer resources are wasted with the help of IoT systems. IoT-based infrastructures integrate the concepts of wireless sensor networks, RFID, cloud computing, and embedded systems to allow real-time sensing and communication, data collection, and visualization, which enhance monitoring, efficiency, and allocation of resources during emergencies (Gubbi et al., 2013; Kucuk et al., 2020).

The Internet of Emergency Services (IoES) can be considered an example of improved coordination among agencies, better decision-making, and greater safety of the population during disasters, medical, and industrial emergencies (Damasevicius et al., 2023). Despite these benefits, one can find issues such as data security, privacy, interoperability, and the cost of the infrastructure. In the future, standardization, the integration of AI and blockchain technology, and the promotion of community involvement are key areas to reduce the research to provide effective, ethical, and scalable systems of disaster management based on the IoT (Damasevicius et al., 2023; Leong, 2025).

2.3 Global Positioning System (GPS)

GPS is an important tool at every stage of disaster management since it offers precise, continuous positioning and time information across the world. Integration with GIS and remote sensing, the 3S technologies, and GPS will assist in real-time mapping of hazards, tracking assets, and analyzing vulnerabilities and damages. GPS improves situational awareness in case of large-scale emergencies when it is pushed together with mobile device information and crowdsourced input (Shafapourtehrany et al., 2023). GPS is also implemented on vehicles, drones, and aero planes to allow large-scale monitoring and coordination (Lewis, 2007). GNSS data, including GPS, are part of the decision-support systems used to map hazards, model evacuation, and evaluate damages to assist with preparedness, response, and recovery operations (Kafi and Gibril, 2016). Hazards and vulnerable areas can be mapped by GPS, which can pinpoint the areas that are susceptible to floods and landslides, and this information can be used to design the land use and evacuation routes, and to come up with an early warning system (Shafapourtehrany et al., 2023).

In case of an emergency, GPS positioning of response teams and UAVs will ensure optimal distribution of resources, and location information available on the devices of survivors will save more lives by shortening the response time (Kafi & Gibril, 2016). Mobile device aggregated GPS traces contribute to the evacuation modelling paradigm and can be used to estimate evacuation rates, understand bottlenecks, and create better routing strategies (Wu et al., 2022). Handheld GPS surveys used in conjunction with satellite imagery and GIS overlays are used in recovery to hasten the process of damage assessment and priorities relief and reconstruction activities. Crowdsourced data are combined with GPS and remote sensing to expand the range of disaster testing coverage, accuracy, and reliability (Shafapourtehrany et al., 2023).

2.4 Google Maps

Google Maps and Google Earth play a central role in disaster management today, supporting preparedness, response, recovery, and mitigation with ready basemaps, satellite imagery, APIs and crowdsourced reporting tools (Roche et al., 2013). The platforms facilitate the identification of the critical infrastructure, evacuation planning, and community preparedness by reducing the obstacles that local agencies and residents can establish and exchange spatial plans (Petersen, 2017; Kawasaki et al., 2013). Crisis mapping and crowdsourced reporting improve situational awareness among the responders and NGOs, particularly at the time of delayed official data (Babayaro, 2012). Integrating the geocoding/API capabilities of Google Maps with social media information or sensor data will assist in real-time mapping of the incident, e.g., a road blockage, building collapse, etc., allowing field operations to proceed efficiently (Sathianarayanan et al., 2024).

Applications for post-disaster are to provide baseline imagery to aid in the assessment of the damage and ranking of recovery resources. Annotated maps and geocoded reports can be used to manage relief effectively, as well as plan restitution by exposing spatial impact patterns (Whitehurst et al., 2022; Singh and Hoskere, 2023). Authoritative layers, such as hazard models and weather feeds, enhance hazard extent and resilience indicators of communication (Paunescu et al., 2025). Computer vision and ensemble learning are more advanced methods that use Google Maps to determine extensive automated damage, but these are dependent on updated images and licensing (Soleimani et al., 2024). To utilize operations efficiently, concerns are needed on connectivity, VGI credibility, licensing, and collaboration with open and authoritative data to achieve strong disaster operations (Goodchild & Glennon, 2010).

2.5 Remote Sensing (RS)

Remote Sensing is the gathering of data related to the surface of the Earth by the use of satellite or airborne sensors. It is also important in managing disasters by offering timely, vast, and repeatable observations, particularly in regions that cannot be accessed. RS allows integrating into the GIS and ground-based data to support the process of risk assessment, early warning, response, and recovery during all phases of the disaster management cycle (Kaku, 2018). Multi-hazard maps that are utilized in the identification of vulnerable regions and exposures to the population can be developed through RS by modelling terrain, land-cover classification, and change detection. Some of the tools used in mapping the floodplains, landslides, and seismic risk areas include Synthetic Aperture Radar (SAR), multispectral images, and Digital Elevation Models (DEMs) that are generated using LiDAR. Integrating satellite time-series and socioeconomic data facilitates risk mapping on probability and pre-disaster mitigation (Odhiambo et al., 2019).

Early-warning systems are based on satellite data such as precipitation estimates, soil moisture indicators, thermal anomalies, etc. Geostationary and polar-orbiting satellite data assist in near-real-time hazard detection of floods, wildfires and droughts. Programs, such as (NASA ARSET), indicate how information derived by satellite enhances the precision of the warnings and the efficiency of the response. Satellite and aerial imagery can be used during disasters to give quick response and recovery assessments. High-resolution optical images, SAR, and drone-based data have proven useful in identifying floods, fire damage, urban destruction, and population displacement. The IFRC and Red Cross are humanitarian organizations that use RS data to priorities field operations by integrating it in the process of rapid assessment (Joseph et al., 2020). The new RS technologies, such as SAR (Sentinel-1), LiDAR and UAVs, have afforded enhanced resolution, precision and flexibility. Machine learning (ML) and deep learning (DL) are the methods applied to automate the process of change detection, object extraction, and hazard mapping.

The study points out that the implementation of AI reduces the speed of data processing and improves emergency decisions (HK et al., 2024). International agencies such as NASA, ESA and UN have institutionalized RS in the disaster management processes. Instead, platforms such as Copernicus Emergency Management Service offer specific mapping products and capacity building. However, poor infrastructure, lack of technical skills, and exclusive data costs still remain a challenge in low-resource regions. Effective implementation is dependent on such factors as sustainable training and institutional partnerships (NASA Applied Sciences). RS has limitations, such as the interference of clouds in optical data, which is expensive to purchase and requires expert skills in data processing. Such ethical issues as privacy and overdependence on remote data also need to be handled. Researchers suggest that RS should be implemented together with participatory strategies to guarantee proper and situational decision-making (Kucharczyk & Hugenholtz, 2021). Due to the new trends, including frequent visits with satellites, AI-based analytics, and open-data projects, disaster management is assuming a new form. The use of operational data is being enhanced through collaboration between space agencies and humanitarian organizations. However, to implement the maximum effect of the RS-based solutions, standardized working processes and interdisciplinary studies are required (Rolla et al., 2025).

2.6 Satellite

Natural (floods, cyclones, earthquakes, wildfires, etc.) and man-made (industrial accidents, infrastructure failure, etc.) disasters are a significant threat to life, property, and the environment. Effective disaster management needs spatial and temporal correct information about hazards, exposure, vulnerability, and impacts. The past few decades have seen the use of satellite technologies like remote sensing, communication and navigation systems in disaster management. They have worldwide coverage, revisit frequency, and dependable communication within the regions where the earth-based systems have failed. Disaster management now provides Earth Observation (EO) satellites on the entire disaster management cycle, including prevention, preparedness, response, and recovery (Le Cozannet et al., 2020). Hazard assessment and impact analysis. Satellites like Synthetic Aperture Radar (SAR) have optical, infrared, thermal and radar sensors, which provide essential data on the impact and hazard assessment. These sensors monitor the flood levels, fire edges, land deformation and infrastructure damage. Nirupama and Simonovic (2002) found that panchromatic, multispectral, and thermal sensors made a significant contribution to disaster mitigation.

Correspondingly, it was emphasized that the Earth Observation (EO) data are systematically connected to all stages of managing a disaster risk (Le Cozannet et al., 2020). Satellite-based communication and navigation systems are also critical, other than imagery. In the event of evacuation, logistics, and field operations, it is now possible to have accurate positioning through global navigation satellite systems (GNSS). Shah (2024) emphasized that satellite communication systems are efficient to substitute the on-ground systems in the disaster-affected areas to maintain continuous emergency coordination and response.

Satellite data with Geographic Information Systems (GIS), terrestrial observations, and artificial intelligence are integrated with the purpose of enhancing the accuracy and timeliness of disaster analysis. The techniques of machine learning and deep learning enhance the assessment of damage and the prediction of hazards.

The results of Lee et al. (2020) indicated that in post-disaster mapping of damage, AI-aided satellite image analysis is much faster in terms of damage mapping and decision-making. At the prevention and mitigation stage, land-use and environmental change are used to identify potentially hazardous areas, including floodplains, landslides and volcanoes through the EO satellites. They also embrace the use of scenario modelling to strategies against any possible hazard. As Le Cozannet et al. (2020) noted, EO technologies can be utilized for prevention, yet they require further development of monitoring vulnerability and exposure toward climate change. Satellite data will be helpful during the preparedness stage to help in evacuation planning, hazard mapping, and locating safe shelters. The GIS-based applications based on satellite data are critical in the distribution of resources and risk evaluation. Vasdev (2019) underlined that these strategies increase community preparedness and resilience. During the response stage, satellites will be used to offer near-real-time situational awareness, damage assessment, and communication. Satellite communication keeps the response teams in touch with each other; high-resolution images detect flooding zones, destroyed infrastructure, and wildfire progression, and so on.

The integration of AI and remote sensing enhances the speed of the assessment and priorities of relief efforts. Under the recovery stage, the satellites would be utilized in tracking the reconstruction, alteration of land use, and other long-term hazard behaviors such as subsidence or aftershock deformation. According to Le Cozannet et al. (2020), despite such massive progress, there remain a few challenges that are high prices of data, lack of capacity to process data, data latency, and technical skills in underdeveloped areas. There are also issues associated with ethicality, institutions of data accessibility and privacy, which need to be addressed. However, the modern developments in satellite, sensor miniaturization, AI-based analytics, and global partnership are the things that are likely to help improve the effectiveness of disaster management. Efficient utilization of the satellite data in disaster-prone countries like India will assist in realizing massive loss mitigation, preparedness, and resilience.

2.7 Wireless Technologies

In case of a disaster, terrestrial infrastructure like wired networks and power systems tends to fail, resulting in disruption of important communication. Wireless technologies provide flexible, quickly deployable, and robust solutions to maintain connectivity, situational awareness, and coordination among responders. Alzyoud et al. (2024) highlight that wireless ad hoc network, which make use of efficient broadcasting and energy-saving algorithms, increase reliability even in the absence of traditional infrastructure. WSNs and IoT devices measure such parameters of the environment as water levels, seismic activity, and wind velocity and send real-time warnings to make faster and proactive decisions (Adeel et al., 2019). Mesh net, ad-hoc WSNs and portable base stations maintain emergency communication and operation when the traditional systems fail. Porte et al. (2020) offered a heterogeneous wireless framework that integrates WSNs, delay-tolerant networking, and HF communications to guarantee connectivity in damaged settings.

The wireless technologies that can be utilized to accomplish disaster coordination, logistics tracking and disaster alerts are cellular networks, Wi-Fi and radio systems. Modern technologies (5G, Wi-Fi 6, drones and mesh networks help to increase the resilience of disasters (Song & Chung, 2025). However, challenges remain. The network reliability is impacted by power failure, interference, and low battery life (Porte et al., 2020. The coordination is hampered by the inability of various agencies to interact (Mohi Ul Din et al., 2024). Operations in inaccessible areas are challenging, and threats to security jeopardies delicate information (Niranjana, 2024). In sum, wireless technologies play a vital role in disaster management, as they allow us to warn of a disaster early, maintain communication, and coordinate it. Along with technical and operational problems, there are continuous improvements which should ensure more stable and less vulnerable wireless systems in future.

3. Objectives of the Study

1. To examine the use of 5G Internet, IoT, GPS, Google Maps, Remote Sensing, satellite, and Wireless Technologies during disaster management.
2. To examine global disaster trends using EM-DAT data in relation to technological interventions.
3. To analyze the existing literature to identify the main practices and problems of these technologies.
4. To suggest an integrated model for actual, technology-based disaster management.
5. To align the study with the Sendai Framework on Disaster Risk Reduction (2015-2030).

4. Research Questions

1. How do modern technologies enhance the effectiveness of disaster management?
2. What insights from EM-DAT data highlight the challenges and opportunities of implementing modern technologies in disaster management?

5. Research Design and Data Analysis

The present study employs a qualitative, descriptive, and analytical design to explore the role of modern technologies such as 5G internet, IoT, GPS, Google Maps, remote sensing, satellite communication, and wireless networks in improving disaster management. This paper is based completely on secondary data collected from reliable and trusted sources, such as the UNDRR, NASA, ESA, EM-DAT data, and numerous peer-reviewed research articles published between 2010-2025. An extensive and systematic literature review and content analysis were employed to identify common patterns, themes, and conceptual links between various technologies. The thematic analysis addressed the functionalities, advantages, challenges, and synergies of 5G, IoT, GPS, Google Maps, Remote Sensing, Satellite, and Wireless Networks throughout the four stages of disaster management: **mitigation, preparedness, response, and recovery.**

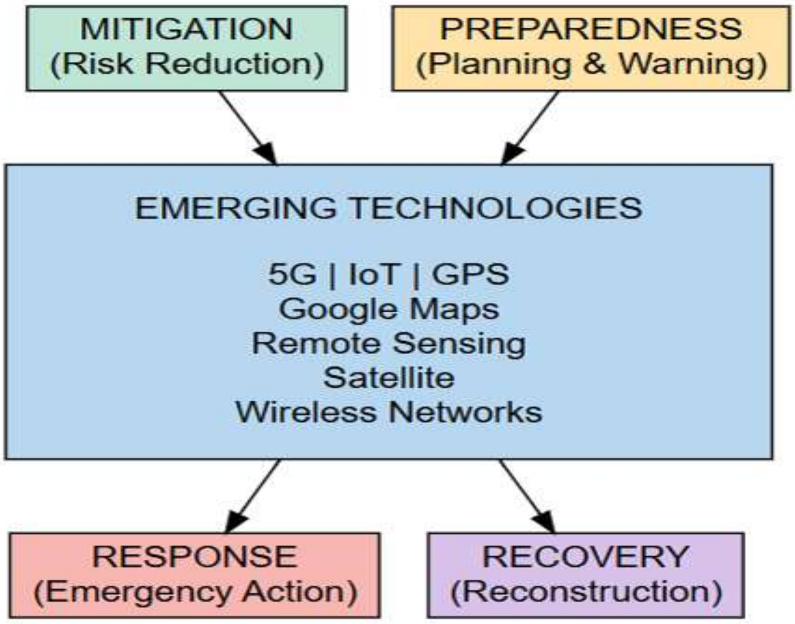

Figure 1: Thematic framework illustrating the role of emerging geospatial and communication technologies across the four stages of disaster management.

Findings from crucial studies such as Le Cozannet et al. (2020), Kapoor and Dwivedi (2024), Damasevicius et al. (2023), and Bolla et al. (2025) were scrutinized through rigorous analysis to clarify the trend of technological paradigms and future changes. The synthesized insights were employed to advocate for a comprehensive technological framework aimed at fostering data-driven and resilient disaster management.

6. Trends, Impacts, and Technological Dimensions of Natural Disasters in India (1980–2024)

This section presents a graphical visualization of major natural disasters that occurred in India from 1980 to 2024. These figures show long-term trends in disaster frequency, loss of life, affected population, and economic losses adjusted for inflation. The data highlights the increasing frequency and impact of natural disasters over time. It also underscores the growing importance of modern technologies for disaster prediction, early warning, preparedness, response, and mitigation.

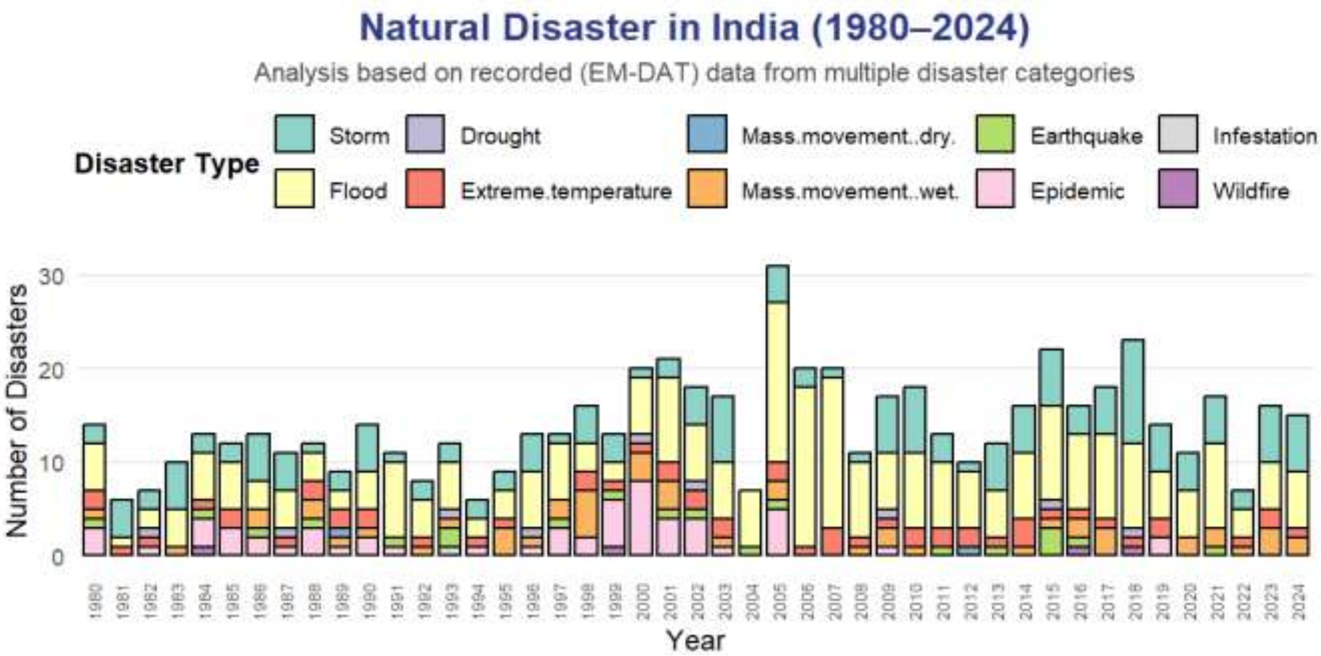

Figure 2: Rising Trend of Natural Disasters in India (1980–2024)

The graph shows the rising rate of natural disasters in India since 1980-2024. Floods and storms have been the most frequent occurrences. This upward trend is a clear indication that there is a great need to incorporate modern technologies like 5G Internet, the Internet of Things (IoT), GPS, Google Maps, Remote Sensing, Satellite communication, and other wireless systems to augment disaster preparedness, monitoring, and response systems in case of disaster management.

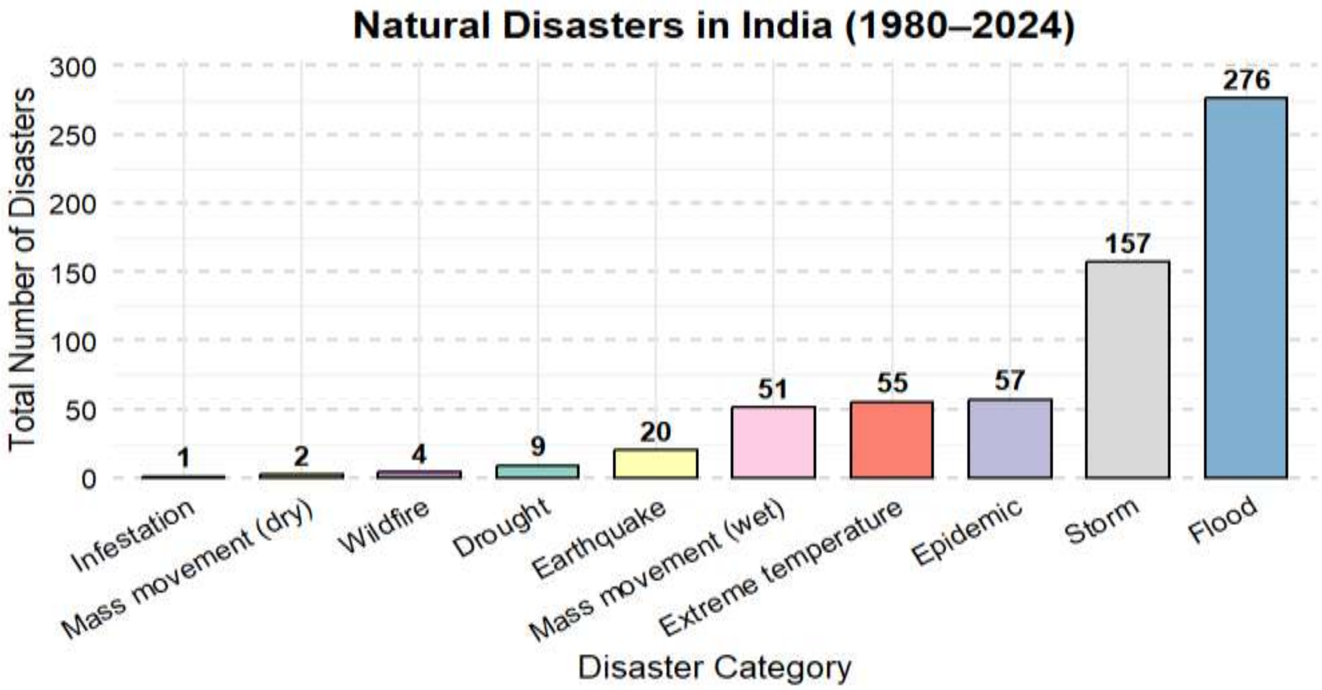

Figure 3: Frequency of Major Natural Disasters in India (1980–2024)

The graph indicates that floods (276) and storms (157) occur most frequently in India during the period 1980-2024. Epidemics (57) and extreme temperatures (55) are moderate events, but droughts, earthquakes, and wildfires are not very frequent. The data shows that weather-associated calamities prevail in the Indian disaster profile, which makes it important to implement efficient monitoring and management strategies.

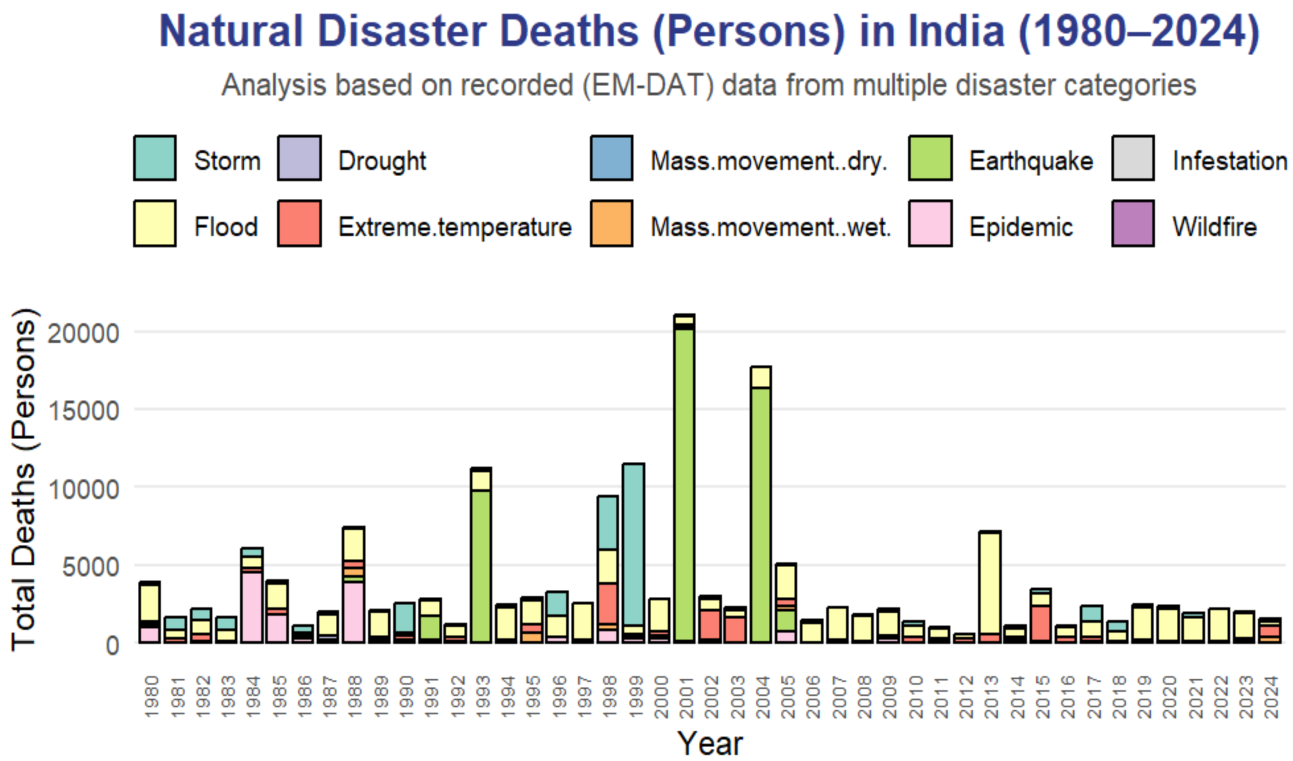

Figure 4: Trends in Disaster-Related Fatalities and the Role of Technology in Disaster Management in India (1980–2024)

The analysis exposes those floods, storms, and epidemics that caused the highest death toll in India between 1980-2024. A visible decrease in fatalities that occurred past 2010 is an indication of better disaster management, early warning systems and health improvements for the people. The use of modern technologies such as 5G, IoT, GPS, and satellite systems has transformed the disaster management strategy into a proactive instead of a reactive one and enhanced the process of disaster management with respect to prediction, coordination, and response. With the help of the Disaster Management Act (2005) and the Sendai Framework (2015-2030), the innovations have reinforced disaster resilience in India and minimized human losses.

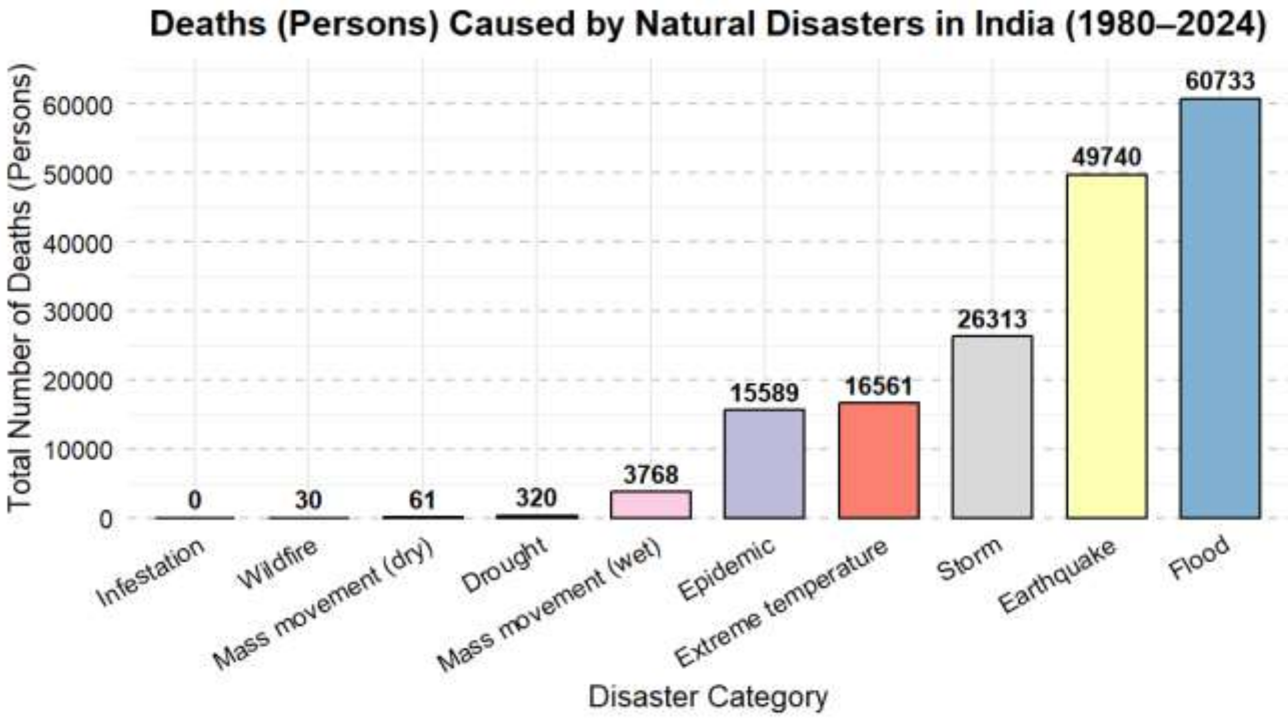

Figure 5: Disaster-wise Mortality in India and the Need for Advanced Technologies (1980–2024)

The graph indicates that the most deaths in India in the period between 1980-2024 were because of floods (60,733 deaths), earthquakes (49,740), and storms (26,313). Conversely, disasters such as infestation, wildfire and dry masses movement were of little effect. This trend highlights the pre-eminence of water and climate-related risks and the necessity of 5G, IoT, GPS, and satellite solutions as the latest technologies to improve early warning, preparedness, and resilience in disaster-related response and management.

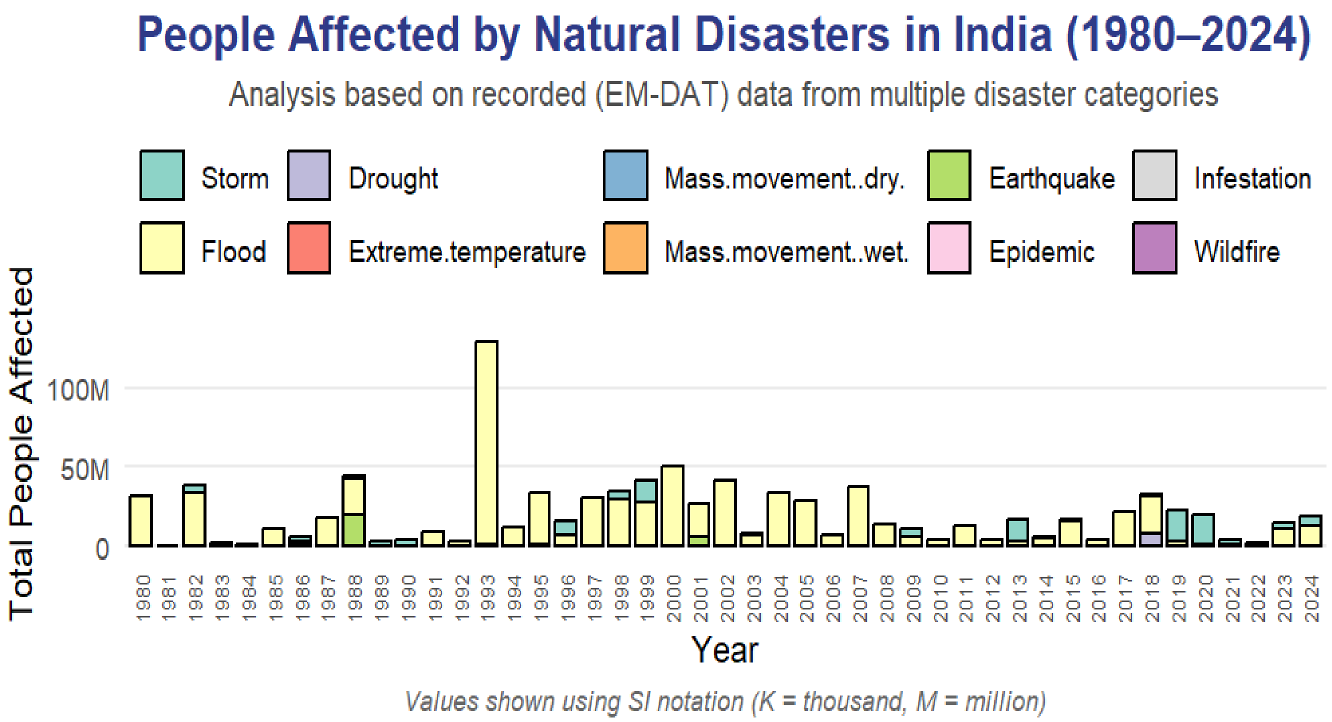

Figure 6: Impact of Floods and Storms on Human Suffering in India (1980–2024)

This graph suggests that the highest number of people in India has suffered because of floods and storms between 1980 and 2024. This stresses the need to embrace superior technologies like 5G, IoT, GPS, and remote sensing to improve disaster preparedness, the early warning mechanism, and reduce human susceptibility.

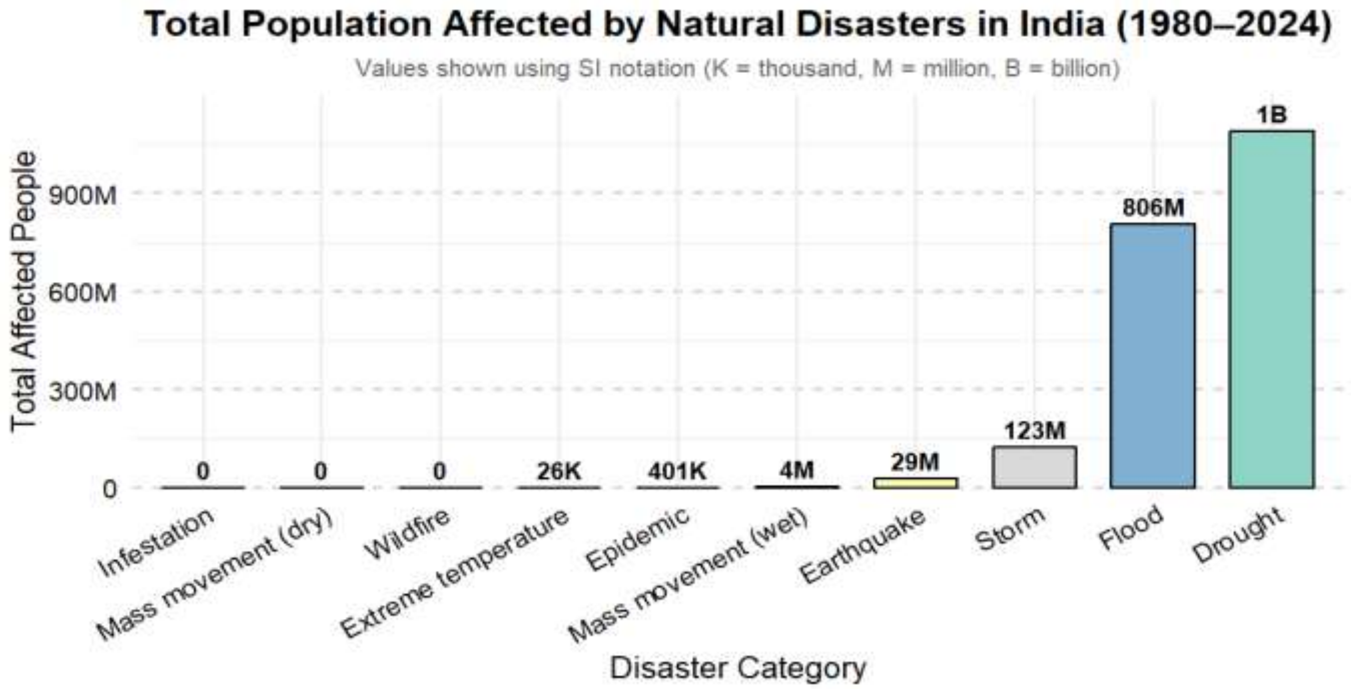

Figure 7: Population Affected by Major Disasters in India (1980–2024)

The graph period between 1980-2024, the highest number of individuals have been affected by droughts, floods, and storms, with droughts affecting over 1 billion people.

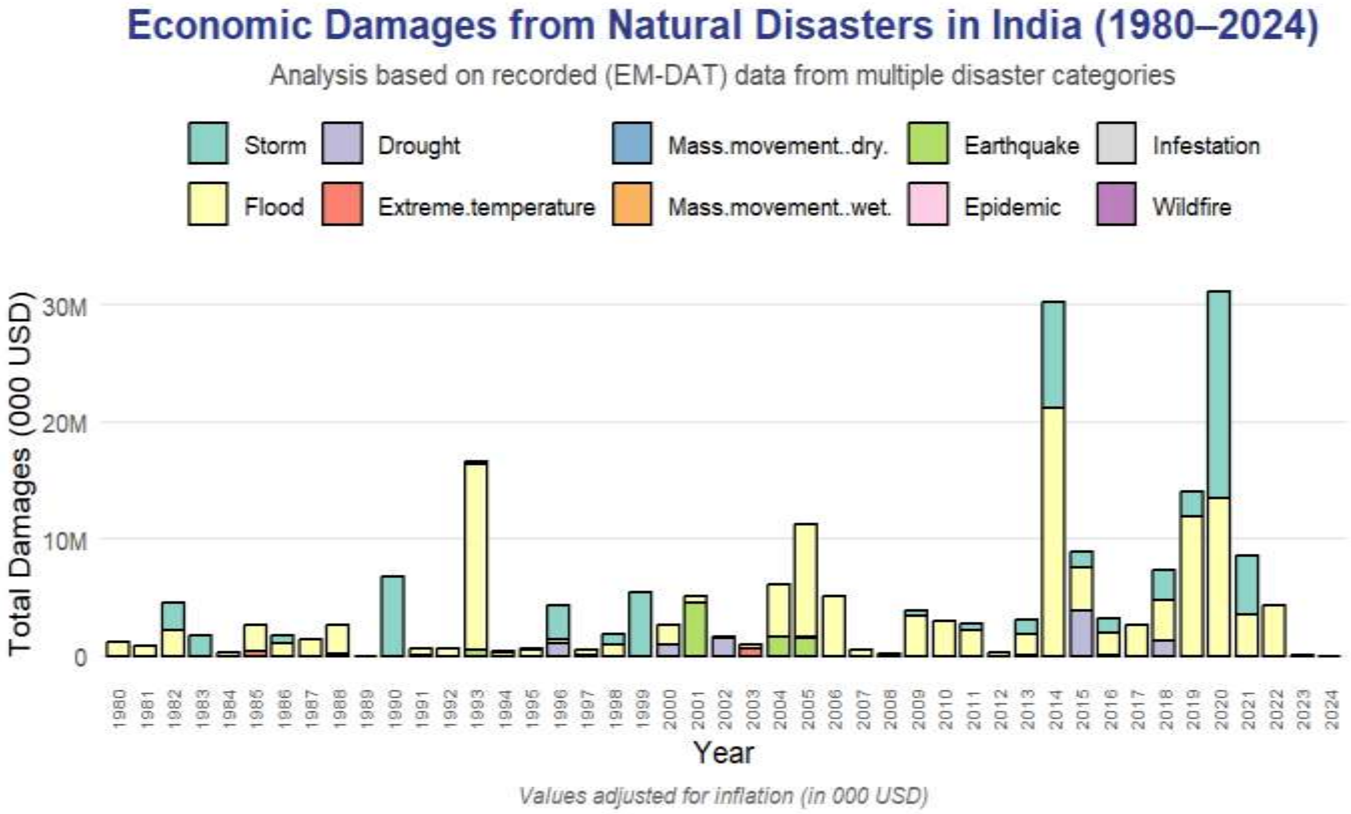

Figure 8: Economic Losses from Natural Disasters in India (1980–2024, Inflation-Adjusted)

The graph shows economic losses of natural disasters that happened in India in the period between 1980-2024 in inflation-adjusted terms. Floods and storms cause the most financial losses, and this explains their high frequency and intensity. The downward trend over the last few years indicates progress in disaster risk management, early warning tools, and robust infrastructure due to the incorporation of technologies into the work of 5G, IoT, and satellite surveillance.

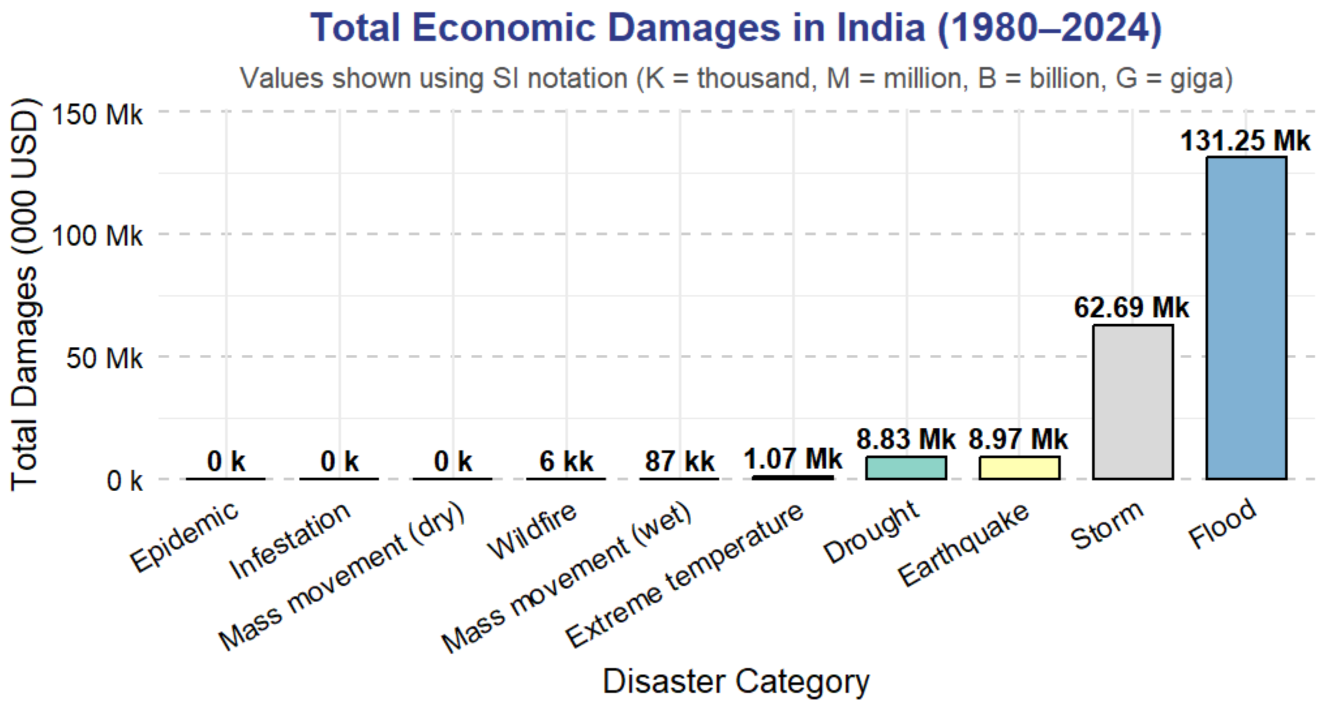

Figure 9: Inflation-Adjusted Economic Losses from Major Natural Disasters in India (1980–2024)

The graph shows the inflation-adjusted economic damages of the big-time natural disasters in India between 1980-2024. The most financial losses were caused by floods and storms, as they are the most prevalent and severe. The fact that the lower damage due to other disasters, like droughts and earthquakes, shows localized effects. These findings demonstrate the applicability of technological integration, such as 5G, IoT, and satellite-based surveillance, in minimizing economic vulnerability and enhancing the ability to endure disasters.

Table 1: Synthesis of Technological Themes in Disaster Management

Theme No.	Theme Title	Key Technologies / Focus	Core Insight
1	Technological Transformation	Overall ICT, RS, GIS, AI	Shift from reactive to proactive disaster management
2	5G and Connectivity	5G, Edge computing, D2D	Enables low-latency communication and coordination
3	IoT and Smart Monitoring	IoT, Sensors, Cloud	Real-time data for early warning and response
4	GPS and Geospatial Intelligence	GPS, GIS, RS	Accurate mapping and evacuation support
5	Google Maps and Crowdsourcing	Google Maps, APIs	Democratized data sharing and community awareness
6	Remote Sensing and Satellite Observation	RS, SAR, LiDAR, Satellite Comms	Global-scale monitoring and assessment
7	Wireless Technologies	Mesh networks, Wi-Fi, Ad hoc	Maintains connectivity during infrastructure failure
8	Integration and Future Directions	AI, IoT, RS, 5G combined	Calls for unified, ethical, and sustainable frameworks

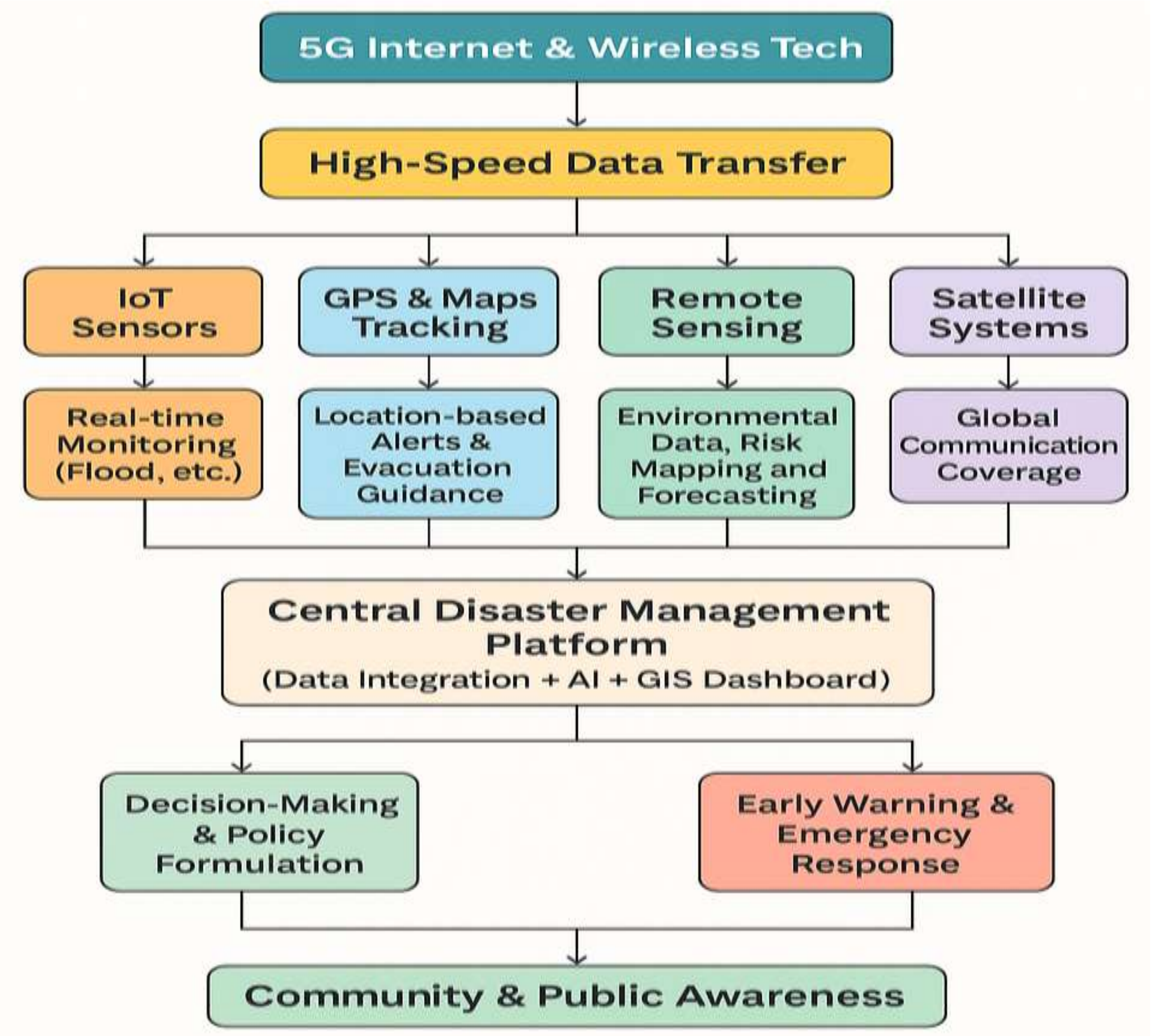

Figure 10: Author's conceptual mapping of 5G Internet and Wireless Technology

The figure highlights a high-tech Disaster Management System as a benefit of 5G Internet, transferring high-speed, real-time data. It integrates data from various high-tech sources: IoT sensors to monitor the ground level, GPS/Maps to track the position and evacuation paths, Remote Sensing to predict the environment, and Satellite Systems to cover the whole world. All these data are input into a Central Disaster Management Platform that serves as a central integration and analysis engine, where AI and GIS Dashboards are used to produce immediate actionable information. Intelligence leads to two vital consequences: it informs the high-level Decision-Making and Policy Formulation and provides swift and coordinated Early Warning and Emergency Response. The final goal is to increase community and public awareness and resilience to disasters.

Table 2: Functional Flow of the Technology-Integrated Disaster Management Framework

Stage	Technology Involved	Function	Outcome
Data Collection	IoT, RS, Satellites	Real-time environmental and spatial data capture	Situational awareness
Data Transmission	5G, Wireless Networks	Instant transfer to command centers	Faster response
Data Analysis	AI, GIS	Predictive analytics, visualization	Informed decision-making
Action & Communication	GPS, Google Maps, Mobile Alerts	Guiding response teams, public warning	Reduced casualties
Evaluation & Feedback	All technologies integrated	Review effectiveness, improve future plans	Continuous improvement

7. Scope of the Study

The scope of this research is to concentrate on the integration and utility of advanced communication and digital technologies in the mitigation of both natural and human-made disasters. The study adopts a global and conceptual perspective, focusing on the universality of technological frameworks rather than a region-specific.

8. Limitations

This study is constrained by its reliance on secondary data, which may inadequately reflect the dynamic and real-time advancements in technology. Furthermore, the rapid pace of technological change can make certain tools or systems outdated in the near future. The study's global perspective further constrains comprehensive regional comparisons or empirical field validation.

9. Ethical Considerations

All scholarly literature and data sources have been meticulously cited and acknowledged in accordance with the Ethics in Research and Publication guidelines. As no human subjects were involved, the necessity for ethical clearance was avoided. The research maintains the principles of integrity, transparency and accountable scholarship in the conduct of the research.

10. Discussion

The results of this study confirm the idea that the implementation of innovative technologies, including fifth-generation (5G) connectivity, the Internet of Things (IoT), Global Positioning System (GPS) and mapping systems, remote sensing, and satellite devices, is a revolutionary paradigm shift in disaster management. The shift brings the field to data-driven preparedness, mitigation, and recovery that is reactive response mechanisms toward proactive measures against threats. These findings are closely connected to the thematic framework of this study, which states that technological transformation (Theme 1), connectivity (Theme 2), smart monitoring (Theme 3), spatial intelligence (Themes 4 and 5) and large-scale observation (Themes 6 and 7) converge into an integrated ecosystem (Theme 8).

10.1 Connectivity and Real-Time Coordination

The 5G networks provide ultra-low latency, high bandwidth, and massive device connectivity features that are important in the case of a disaster, where there is a need to coordinate many agencies in a short time span. According to past literature, device-to-device (D2D) and edge computing are supported by the 5G technology and allow ensuring connectivity even in cases where physical infrastructure is destroyed (Velev et al., 2018; Kaleem et al., 2018; Adeel et al., 2018). The present study helps in better coordination of first responders, drones, IoT sensors, and command centers, thus increasing the robustness of real-time situational awareness and enhancing resource allocation.

10.2 Sensor Networks and IoT Monitoring

The sensor networks of IoT are the basis of the real-time acquisition of environmental data regarding the parameters. These include the level of water, seismic motion, and the speed of the wind. These systems are crucial to the early warning mechanisms as proven in the previous literature (Leong, 2025; Zeng et al., 2023; Adeel et al., 2018). In the present research, it is emphasized that in the case of integrating IoT infrastructures with wireless technologies and 5G, they become the eyes and ears of the forecasting systems. However, another important issue is also revealed in the findings, particularly the problems of interoperability, data standardization, and protocol diversity that create impediments to large-scale implementation in developing countries.

10.3 Geospatial Intelligence: GPS and Mapping Platforms

The use of GPS technologies and mapping, including Google Maps, can significantly boost disaster operations by providing better evacuation planning, logistics, and real-time monitoring of the assets. These are tools that are commonly recognised to boost spatial precision and situational mapping (Shafapourtehrany et al., 2023; Petersen, 2017). The current findings show that these kinds of geospatial applications enhance decision-making in the hazard zone and route rescue. Their performance, however, is based on the quality of mapping data, consistency of connectivity and how well the local authorities process the spatial intelligence and convert it into action.

10.4 Remote Sensing and Satellite Technologies: From Observation to Action

Satellite technologies and remote sensing technologies expand the scope of disaster monitoring to regions that are either inaccessible or highly damaged. They allow full damage evaluation and monitoring of post-disaster recovery. The literature reviewed has shown that synthetic aperture radar (SAR), LiDAR, and multispectral imagery can be valuable in hazard mapping and change detection (Saputra et al., 2025; Zeng et al., 2023). The satellite data can also be used as a component of a centralized disaster management system where evidence-based decisions could be made at each mitigation, preparedness, response, and recovery phase.

10.5 Wireless Technologies and Resilient Communication

Wireless communication-based systems like mesh and ad hoc networks are used when the traditional communication infrastructure fails to provide continuity of communication. The findings prove the fact that such networks are essential to support the coordination between emergency teams and the affected population, which is in line with previous research (Adeel et al., 2018). However, the study also points out that there are still issues like power supply limitations, signal interference, and geographically remote or rugged area deployment challenges.

10.6 Synergistic Integration and Framework

One of the unique aspects of this work is the focus on the synergistic combination of various technologies (IoT, 5G, GPS/Google Maps, remote sensing/satellites, and wireless systems) into one system of work. The conceptual framework proposed shows how all these elements can be used to support a central AI/GIS-based decision-making platform which runs on heterogeneous streams of data. The given holistic approach fills a research gap that has been identified as critical in previous studies, as technological components were frequently studied separately but not as interdependent factors (Adeel et al., 2018; Peng et al., 2025). Overall, the present study identifies major intuitive policy requirements such as investment in resilient infrastructure, data standardization, data literacy, inclusive governance, and ethical data usage as the first step to sustainable technological integration.

10.7 Limitations and Practical Challenges

Despite the bright future, there are several problems that hinder the popularization of these technologies in the management of disasters. The high infrastructure cost, the lack of interoperability, cybersecurity, and privacy of data are still major challenges (Moudoud et al., 2022; Moudoud et al., 2021). Since the research is based mainly on secondary data, empirical validation of integrated systems remains a limitation. However, the emphasis on inclusivity and ethical issues is in line with the new criticisms that propose to adopt a participatory and equitable learning approach in adopting technology (Kucharczyk & Hugenholtz, 2021).

10.8 Implications for India and Developing Countries

In the Indian context, the research highlights the rising significance of applying technology in the wake of the rising vulnerability to climatic disasters like floods and cyclones. After the Disaster Management Act (2005) and the Sendai Framework on Disaster Risk Reduction (2015-2030), the outcomes are that developing nations have opportunities and limitations with their own peculiarities. The use of such technologies as 5G, IoT, and satellite systems can be used to overcome the shortcomings of the legacy and take a step forward, but success will rely on the challenges of cost, connectivity, governance, maintenance, and digital literacy. Thus, long-term investment in ICT infrastructure, encouraging public-private collaboration, and building community-oriented, capacity-building events are the main aspects of ensuring the creation of resilient, technology-focused disaster management.

11. Conclusion

This paper finds that the integration of high-tech digital solutions, particularly 5G Internet, the Internet of Things (IoT), GPS and mapping systems, remote sensing, satellite communications, and wireless networks, has changed the nature of the disaster management paradigm. It is possible to receive real-time information through integrated technologies, which will provide fast and effective communication, proper geospatial mapping, and predictive analytics, which support all disaster management actions, including mitigation, preparedness, response, and recovery. Their collusion indicates the shift of reactive response systems to proactive, data-driven, and anticipatory mechanisms that can reduce the losses of human beings and economic resources. The findings highlight that 5G and wireless communication frameworks constitute the operational foundation for low-latency, high-reliability coordination in times of crisis. The IoT-based sensor systems and remote sensing technologies help in the creation of continuous and multi-source environmental data, which enables the formation of early warning systems and risk assessment.

Similarly, GPS and geospatial mapping platforms, displayed by Google Maps, enhance spatial precision, situational awareness, and evacuation strategy development, while satellite-based systems assure uninterrupted monitoring and communication even in scenarios where terrestrial networks are compromised. All these technological advances contribute to the creation of a proactive, predictive, and participatory disaster management model with the importance of synergy, interoperability, and real-time decision-making. The study identifies the need to have sound policy frameworks, investment in the resilient ICT infrastructure, capacity building and community involvement. The developing countries like India have the ability to leverage these improvements and overcome the past limitations, if the problems that surround cost, governance, standardization, and digital literacy are tackled in a systematic way.

12. Future Research Directions

Future studies should priorities the empirical substantiation of multi-technology integration frameworks via real-time disaster simulations and field-based case analyses. Also, there is a strong necessity to analyses the ethical, legal, and governance implications related to the widespread data sharing in crisis scenarios. Also, the advancement of AI and GIS-enabled platforms for predictive modelling and decentralized decision-making has the potential to vastly enhance adaptive capacity and resilience. Such investigations would add value to the understanding of how digital convergence can lead to sustainable change in managing disasters in both developed and developing nations.

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