International Journal of Engineering Sciences & Research Technology
(A Peer Reviewed Online Journal)
Impact Factor: 5.164

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INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY
ENHANCING DISASTER MANAGEMENT IN INDIA THROUGH ARTIFICIAL INTELLIGENCE: A STRATEGIC APPROACH

Paril Ghori
parilghori@gmail.com

ABSTRACT
Disasters cause significant damage to India's people, economy, and environment, particularly due to the country's susceptibility to natural calamities like floods, earthquakes, cyclones, and droughts. To address these challenges, a strategic disaster management approach is vital, integrating modern technologies such as artificial intelligence (AI). AI can play a crucial role in predicting and preventing disasters, assessing their impacts in real-time, and guiding rapid interventions. By improving early warning systems, optimizing resource allocation, and supporting recovery strategies, AI can help minimize the damage caused by disasters. This study emphasizes the need for a dynamic disaster management framework that incorporates AI to strengthen India's resilience. It explores various applications of AI, demonstrating how these technologies can enhance disaster prediction, response, and recovery, ultimately contributing to a more proactive and sustainable approach to disaster management in India.

KEYWORDS: AI, Disaster Management, Machine Learning, NDMA.

1. INTRODUCTION
Our world is constantly faced with the horrors of many disasters such as earthquakes, floods, epidemics and political unrest. As the scale and complexity of these events increase, the need for more efficient strategies to manage them effectively also increases. There is not enough scientific research on the concept of strategic disaster management, which is a disaster management approach that integrates disaster prevention, disaster response and post-disaster recovery levels. Considering this need, this article presents all dimensions of the concept of strategic disaster management within a comprehensive framework. This framework includes many elements including prevention, preparation, response, recovery, governance and capacity building. Because the strategic management of a disaster includes the stages of creating a strategic plan for the disaster, implementing this plan and evaluating it. With the rapid change in technology and the development of artificial intelligence (AI), strategic disaster management has begun to become a viable option to cope with the increasing list of risks threatening our communities and the environment. Artificial intelligence technologies can help minimize the effects of disasters and reduce the cost of resources required to address them. Because these technologies can include features that enable us to quickly detect, predict and respond to disasters, and can also be used to create innovative solutions in these areas. In this study, it is argued that artificial intelligence has many areas of use in strategic disaster management and that using artificial intelligence in strategic disaster management is necessary for the effective use of resources. This article aims to shape the strategic disaster management system, which should be established and implemented for effective response to disasters, with artificial intelligence technologies, thus contributing to the effective use of all resources at hand at the time of disaster. In the first part of this article, a conceptual analysis is made and the concepts of disaster, disaster management, strategy, strategic management and artificial intelligence are explained. In the second part, strategic disaster management, which should be implemented to prevent and respond to disasters in a timely and effective manner, is explained with all its stages. Then, the areas of use of artificial intelligence in strategic disaster management, the disadvantages and advantages that the use of artificial intelligence in this field may bring, are presented. In the last part of the article, a general evaluation of this study is made. The findings obtained as a result of these evaluations; strategic disaster management is an important and necessary component of the disaster cycle and a comprehensive framework needs to be developed to effectively combat and recover from disasters, and while developing and implementing this framework, it is important to utilize artificial intelligence technologies in terms of efficient use of resources. In general, in this article, in order to explain the accuracy of this argument and to reach the goal, the qualitative research method

ISSN: 2277-9655
[Ghori* *et al.,* **10(10): October, 2021]**   **Impact Factor: 5.164**
IC™ Value: 3.00   **CODEN: IJESS7**

was used and the information was obtained through literature review and archive research technique. With the findings obtained as a result of the method used to investigate the accuracy of this argument, data on which processes and in which areas artificial intelligence technologies can be used in strategic disaster management were presented and it was concluded that artificial intelligence-based technologies have a very strong potential in the field of predicting disasters and responding to disasters that occur due to lack of protection and use of this potential will make significant contributions to strategic disaster management. This study concludes by calling for further research on the use of artificial intelligence in strategic disaster management in order to ensure that disaster management produces effective results and that sufficient resources are allocated to this area in the future.

2. CONCEPTUAL FRAMEWORK

This section explains the main concepts of the article, namely strategy, strategic management, disaster and disaster management.

2.1 Strategy and Strategic Management

Strategy is a set of comprehensive plans or actions to achieve a desired goal and is a coordinated and well-defined series of steps taken to achieve the result. It is also a combination of decisions and actions taken to achieve a specific goal. Strategy is a way for organizations to implement their plans to achieve their goals. Strategies are determined and implemented to optimize financial resources, identify market and geographic opportunities, and develop a competitive advantage in the market in which they operate. Business strategy is usually determined and developed by the top management responsible for managing the activities of an organization (Ocak and Güngör, 2020).

The purpose of the strategy is to enable the organization to maximize its potential and achieve a sustainable advantage. Organizations that understand the importance of developing a strategy are generally more successful than organizations that do not have this understanding. Developing a strategy helps organizations focus their activities and direct them towards their goals. It also enables them to anticipate and respond to changes in the business environment. With a well-defined strategy, resources are allocated to specific areas to maximize results. This prevents organizations from floundering in the wrong areas and wasting valuable resources. Strategy also helps organizations develop their competitive advantage. Developing a good strategy requires understanding the environment and organization in which you operate. Once the strategy is developed, it should be communicated to all stakeholders. This includes management, employees, and service providers. In order for organizations to be successful, everyone needs to understand and embrace the strategy. Implementing well-defined strategies that include all stakeholders is the key to success in any business (Güngör and Özdamar, 2020).

Strategic management is the process of defining an organization's strategy or direction and making decisions about allocating resources to sustain this strategy. This management model includes the processes of formulating, implementing, and evaluating the organization's strategy and tactics. While defining the strategy and making strategic decisions to support it is the responsibility of the organization's top management, strategic management includes processes based on the effective participation of all stakeholders. In this respect, strategic management is the key to success in any organization, as it helps the organization determine the best course of action to achieve its goal (Knapp, 2020).

All organizations that want to achieve their goals first determine their goals and objectives while implementing strategic management, which has certain stages. Establishing the organization's goal and the scope of the goal is the first and most important step in developing a good strategic management model. This stage includes defining the organization's purpose, vision, mission statement and general goals. After the first stage, the organization's internal and external environment must be analyzed. Because in order to develop an effective strategy, an organization's managers must first understand their own competitive environment and the internal capabilities of their organization. This necessitates a comprehensive analysis of both internal and external factors affecting the organization. The next step after analyzing the internal and external environment is to develop a strategy to achieve the organization's goals and objectives. This stage includes; setting strategic goals, developing a competitive strategy and industry analysis. The strategy implementation stage includes creating action plans and allocating resources to ensure that the strategy is implemented cost-effectively and on time. After the strategies are implemented, the stage of evaluating the results begins. This evaluation requires measuring progress according to

the organization's goals and objectives, making necessary corrections, and ensuring that the strategy is implemented as intended (Özdemir, 2021; Genç and Bulut, 2021).

Strategic management is the entire process of determining organizational goals, developing tactics to achieve goals, allocating resources to implement tactics, and evaluating what is done as a result of this allocation. A good strategic management model helps organizations define their competitive advantages, develop a clear vision for the future, and create an effective strategy to achieve their goals. Since a good strategic management model also helps organizations plan their long-term growth, manage risks, and make better decisions, a management cycle that redesigns the process with the data at hand by creating an adaptable and effective strategy, implementing it, and evaluating the results of the implementation ensures that the organization remains competitive and successful in a constantly changing business environment (Yılmaz and Küçük, 2020).

2.2 Disaster and Disaster Management

A disaster is an event or set of events that has a negative impact on the environment, community, or the economic well-being of a specific area, country, or region. There are various types of disasters, from natural disasters to man-made disasters to technological disasters. It is important to understand the various types of disasters and their effects in order to properly prepare for and manage a disaster. Natural disasters are disasters caused by natural factors such as floods, earthquakes, volcanic eruptions, landslides, and hurricanes. Natural disasters can cause significant damage to infrastructure, homes, workplaces, and lives. Man-made disasters are disasters caused by humans and include industrial accidents, chemical leaks, fires, transportation accidents, and other types of disasters caused by human negligence or error. These disasters can be caused by human activities such as poor environmental management or industrial accidents. Technological disasters are disasters caused by technology, such as nuclear reactor accidents. These disasters can be caused by equipment failure or other technological problems (Göksun, 2020; Güner, 2016; Tilburg and Başoğlu, 2018).

Disaster management is the entire process that includes predicting, preventing, and reducing the effects of a disaster, as well as preparing for, responding to, and recovering from the effects of the disaster. In the event of a disaster, the main goal of disaster management is to minimize the potential damage of the disaster and to help the affected region and its people recover as quickly as possible. This can be done through effective planning and coordination of activities by governments, non-governmental organizations (NGOs) and other organizations. The steps of disaster management generally include some stages. The first of these stages is the disaster preparation stage, which includes estimating and preventing the consequences of the disaster by identifying possible disasters and their risks. This stage includes developing plans such as evacuation plans, emergency response plans and hazard maps to reduce potential risks for the disaster. The second stage is the disaster response stage, which includes the coordination of the disaster response, such as the deployment of personnel and the provision of medical treatment, food and shelter. The third stage is the disaster recovery stage.

This stage includes restoring basic services such as electricity, water and communication, as well as providing psychological and financial assistance to the people affected by the disaster. During and after a disaster, it is important to ensure that the affected region and people receive the necessary resources and assistance for full recovery. The role of governments, NGOs, and other organizations in disaster management is crucial in this sense, and these stakeholders can provide vital assistance to help those affected by disasters get back on their feet. In addition to the steps above, some countries have adopted the so-called "all-hazards" approach to disaster management, which focuses on reducing the risks associated with all types of disasters and preparing for all possible outcomes. This approach consists of detailed planning activities such as mapping vulnerable areas, assessing available resources, and coordinating response and recovery efforts. In general, effective disaster management is necessary to minimize the damage caused by disasters and help affected people recover quickly. Disaster management not only saves lives and property by preparing for, responding to, and recovering from disasters, but also helps to return to normal conditions in disaster-affected areas (Tilburg and Başoğlu, 2018; Göksun, 2020).

Disaster management is the process of determining, planning and implementing strategies to reduce the effects of disasters and eliminate or reduce the damage caused by disasters. This includes identifying potential risks, developing and implementing emergency plans, training personnel and providing resources for rescue efforts. The aim of disaster management, which includes all these processes, is to reduce the impact of disasters on the

environment, society and economy. Because disasters can have devastating effects on the environment, society and economy. In order to reduce these devastating effects, developing effective plans within the scope of strategic management and effectively managing the available resources within these plans is absolutely necessary to minimize the effects of a disaster (Kıyak and Şahin, 2021; Üçer, 2020).

2.3 Artificial Intelligence

Artificial intelligence is a field of computer science that focuses on creating machines that can think like humans. The development of artificial intelligence is based on the idea that machines can understand, learn and apply information like humans, and is one of the fastest developing technologies of today. With this technological development, artificial intelligence applications have become increasingly diverse over time. The first concrete step in artificial intelligence was taken in the 1950s. In 1956, a group of scientists at Dartmouth College proposed the first artificial intelligence project, which they called the "Dartmouth Project". After the developments that have taken place since then, artificial intelligence technologies are used in various fields including robotics, image recognition, and natural language processing and autonomous vehicles. Recently, artificial intelligence has become more popular and applications using this technology are encountered in every field (Ma et al., 2019; Bhushan, 2020).

Companies such as Google, Amazon and Apple are making large investments in artificial intelligence research and these investments increase the number of news stories about new developments every day. Artificial intelligence technologies are also used to create facial recognition systems, driverless cars, personal assistants and other innovative applications, and their potential areas of use are becoming increasingly diverse. Developments show that artificial intelligence will continue to expand into new areas such as health, finance and manufacturing. Artificial intelligence is creating a revolutionary change in the way these industries work and its impact on society is progressing in a more comprehensive way. As the process of making machines smart with the use of artificial intelligence and the areas of use of this development progress, these machines may begin to take over most of the work currently done by humans. This situation will have significant effects on the functioning of the economy and, as a result, significant changes can be observed in labor requirements. Therefore, artificial intelligence and its applications, which are a rapidly growing field of computer science, will become increasingly diverse and can provide significant advances in many areas, while it may have some negative consequences in the field of employment. For this reason, as developments in artificial intelligence continue, there is a need for studies that will foresee the potential impact of artificial intelligence in different areas (Huang, 2019; Deng et al., 2020; Kumar et al., 2019).

3. STRATEGIC DISASTER MANAGEMENT AND THE ROLE OF ARTIFICIAL INTELLIGENCE

In this section, the concept of strategic disaster management and the stages of this management and the issues to be considered when designing and implementing strategic disaster management are explained, and then the functions and roles that artificial intelligence has and can acquire in strategic disaster management are analyzed.

3.1 Strategic Disaster Management

Disaster management is the entire process that includes the steps of predicting, preventing and reducing the effects of a disaster, and preparing for, responding to and improving the effects of the disaster. Strategic management includes the processes of formulating, implementing and evaluating strategies and tactics. Therefore, strategic disaster management is the entirety of decisions, actions and analyses that include planning what to do before and after a disaster, implementing these planned strategies and actions at the right time, with the right resources and in the right place, and reviewing, or revising, the entire plan by evaluating the implementation results of the implemented plan (Akyürek, 2019).

In the step of preventing the possible effects of the disaster; a natural disaster plan is developed that includes specific and step-by-step instructions for preventive measures in the event of a potential disaster. Developing mitigation strategies to reduce the impact of a disaster, creating emergency plans and taking other proactive measures are very important at this stage, and it is necessary to develop safe land use plans and implement early warning systems to monitor natural disasters using satellites, radios and other technologies to reduce the risk of disasters. In addition, at this stage, it is of great importance to analyze the existing hazards and risks in the area, including natural, man-made and technological factors, to establish fire, security systems and surveillance systems

to warn local authorities and individuals against potential disasters, to increase the disaster awareness of the personnel in charge and to train these personnel on disaster preparedness and risk reduction strategies, to monitor weather conditions and other statistical data about nature and to take appropriate measures to reduce the risk of natural disasters. One of the most important issues at this stage is the need to identify the risks faced for the use and allocation of resources in priority areas and to assess the probabilities and potential impacts (The World Bank; 2021).

In the disaster preparedness stage, an emergency response team with technical, administrative and operational expertise is formed and this team is trained on all aspects of disaster preparedness and response, especially training this team on how to respond to different scenarios and ensuring that they are adequately equipped to cope with disasters. It is of great importance to develop an evacuation plan and inform the response team about this plan and its duties and to conduct drills on this subject, to establish a system to monitor disasters as soon as they occur and to ensure that the team is informed about this, to stock basic materials, equipment and resources to be used in the event of a disaster and to develop an emergency communication plan to ensure that all stakeholders have access to the latest information, and to establish clear protocols for both internal and external communication in this plan, that is, to prepare protocols that include communication with the public, the media and other external stakeholders (Wein et al., 2018; Akyürek, 2019).

In the disaster response phase; It is of great importance to establish a crisis management center where key personnel can work together, to develop an incident command structure with clear lines of authority and decision-making, to coordinate search and rescue efforts in harmony with local authorities, to ensure that the emergency response team takes action quickly and that the entire team is effectively coordinated to provide the most effective response, to make the necessary planning for the accurate determination of needs and the allocation of resources to these needs, to make warnings so that the response processes and activities are carried out safely and regularly, to determine and implement the correct evacuation methods, to provide medical treatment to disaster victims on-site or from the nearest safe place, to ensure that basic goods and services reach disaster victims with shelter services, and to ensure that the coordination of aid and relief efforts to be made to ensure the safety and well-being of individuals in the disaster area is effective, to meet the physical, emotional and psychological needs of the response team during the process and to ensure that up-to-date records of individuals affected by the disaster are kept (Akyürek, 2019).

Another important process in disaster management is the rescue process, and during this process, it is very important to create a system to evaluate the damages, losses and the impact of the disaster, to help disaster victims rebuild their lives and to make the financial and psychological support to be provided to disaster victims sustainable until the normalization process, to plan the reconstruction and restoration of damaged areas and infrastructure, and to implement the plan at the right time and place (Eren and Akdaş, 2021).

Finally, in the evaluation phase, it is necessary to continuously monitor all stages in strategic disaster management processes and analyze the impact experienced after the steps taken in order to improve future efforts. In this way, the effectiveness of preparation, intervention and rescue is evaluated, successful and areas that need improvement are identified, data on strengths and weaknesses are analyzed, and the information obtained can guide future planning studies (Wein et al., 2018).

It is important to take the following points into consideration in the design of strategic disaster management:
1. Developing a general disaster management strategy: Developing a general strategy that outlines the roles and responsibilities of everyone involved and the general goals for disaster response (Norman, 2018),
2. Identifying potential risks: Identifying and assessing potential risks that may arise from natural disasters, man-made disasters, and even technological disasters (Büyüköztürk et al., 2017),
3. Creating a disaster plan: Creating a written plan to respond to different types of disasters and assigning appropriate personnel or organizations to respond to different types of disasters (Bennet and Ballou, 2016),
4. Planning for effective resource allocation: Preparing resources, such as personnel and equipment, required to respond to a disaster in a timely manner and allocating them effectively to needs (Yüksel and Tuncay, 2021),

5. Managing communication quickly and accurately: Creating a communication system to ensure that all stakeholders are informed about the plans and progress of disaster response (Yüksel and Tuncay, 2021),
6. Training personnel on disaster response: Providing personnel training to respond to disasters quickly and efficiently (Brown, 2021),
7. Reviewing the implementation of disaster plans after actions: Conducting a review after each disaster to evaluate the effectiveness of the disaster plan, identify deficiencies in the plan, and identify changes that need to be made (Erdemir, 2021),
8. Maintaining records: Keeping records of actions taken during each disaster for future reference (Norman, 2018),
9. Monitoring and reviewing strategies: Periodically reviewing current strategies and plans to ensure they are up-to-date and effective (Suzuki, 2018),

Local governments are undoubtedly the most important institutions with key importance in strategic disaster management. In this context, determining strategic disaster management processes is of great importance for local governments. A strategic disaster plan should be developed for local governments that includes specific and step-by-step instructions for preventive measures in the event of a potential disaster. The preventive measures that should be included in this disaster plan can be summarized as follows (Yakut and Sevinç, 2016; Öztürk and Tuncel, 2019; Dicle et al., 2017):

- It is necessary to analyze the risks related to natural disasters in the region and to create an emergency management plan. This plan should include risk assessment, mitigation strategies, intervention strategies and recovery strategies.
- A public education campaign should be developed. This campaign should provide information about the types of disasters that may occur in the region and the steps that will help educate and prepare the public.
- Vulnerable populations should be identified and strategies should be developed to protect them during a disaster.
- An evacuation plan should be created and this plan should be shared with the public and made accessible to them. In this context, the locations of safe shelters should also be announced.
- Communication and warning systems should be established to warn the public in the event of a natural disaster.
- A disaster response system should be established for local government and local institutions.
- Plans should be developed to provide basic services such as food, water, and medical care during and after a disaster.
- Local emergency response teams should be established to assist in the response to a natural disaster.
- Resources to be used in the event of a disaster should be identified.
- Plans should be developed to restore infrastructure and economic activity after a natural disaster.
- Changes in climate and weather patterns that may indicate an impending natural disaster should be monitored.
- Funding sources and potential resources for natural disaster preparedness, response, and recovery should be identified in advance.

The purpose of the strategic disaster management plan of local governments is to help them analyze and manage the risks related to natural disasters in their provinces or districts, and this plan should provide guidance in identifying potential hazards, understanding their effects, and developing strategies to reduce the risk. The plan should clearly define the roles and responsibilities of all emergency management personnel included in the plan, and the relevant personnel should be trained in this regard. Within the scope of this plan, municipalities should identify potential natural disasters that may affect their province or district. These hazards should include floods, landslides, earthquakes, forest fires, and windstorms. After identifying potential disasters, municipalities should evaluate the potential effects of the identified hazards. In this assessment, the population, infrastructure, and environment of the province or district should be taken into account. Then, municipalities should analyze the risks related to the identified hazards. This analysis should consider the probability and potential impact of the effects of the identified hazards. An emergency response plan should be prepared after the risk analysis and assessment (Müller and Blasi, 2018).

This plan can be divided into three parts. In the first section, the disaster preparedness process is determined and in this stage, the municipality should develop a preparedness plan to ensure that it is ready to respond to any emergency (Morris, 2016). This preparedness plan should include developing emergency response procedures, identifying resources, and training personnel, determining drills to be conducted, and conducting drills. In the second section, the disaster response process is determined and municipalities should develop a response plan to address the immediate effects of the identified hazards (Rosenberg Matthew, 2017). This plan should include providing emergency shelter, medical support, food, and water to citizens affected by the disaster. In the second section, the recovery process that reduces the effects of the disaster should be determined and in this stage, municipalities should develop a recovery plan to address the long-term effects of the identified hazards (Tarm, 2014). This plan should include repairing damaged infrastructure, providing psychological support, and supporting economic recovery. This strategic disaster management plan will provide guidance to municipalities to analyze and manage the risks associated with natural disasters in their provinces or districts. Municipalities that want to manage disasters well should identify potential hazards and assess their impacts, analyze risks, develop a preparedness and response plan, and develop a recovery plan. By implementing such a plan, municipalities will be able to reduce the risk of natural disasters and protect the health, safety, and well-being of their citizens (Ferraro, 2019).

Natural disasters are a fact of life that cannot be ignored (Arya, 2018). As the frequency of such disasters increases, it becomes even more important to understand how the risks of such events are determined. The primary factor affecting the risk of a disaster is the location of a particular area (Özberk, 2021). Areas that are more prone to natural disasters such as earthquakes, floods, landslides, and storms are at higher risk than areas that are less prone to such events. Other factors such as the building materials used and the age of the structures can also affect the risk of a disaster. In addition to the physical characteristics of a particular area, various social and economic factors should be taken into account when assessing the risk of a disaster (Thoma, 2016). These should include population density, gross domestic product, and poverty and inequality. All of these factors should be combined to create a risk profile for a given area and used to estimate the probability of a disaster occurring in that area. Climate change is one of the important factors considered when assessing disaster risks. As the climate changes, the probability of certain types of natural disasters occurring also increases. Finally, risk assessment techniques such as forecasting techniques, risk mapping, actuarial science, and underwriting are used to assess the risk of a disaster. These methods are used to assess the probability and severity of a particular event and to provide a basis for making decisions regarding disaster preparedness and response. Therefore, disaster risks are determined by a combination of physical, social, economic, and climate-related factors. By understanding these factors and using appropriate methods, it is possible to accurately estimate the disaster risk in a given area and take the necessary steps to prepare for and respond to such an event (Martin, 2019).

When designing the processes that municipalities in India must follow to analyze the risks related to natural disasters in their states or districts, the following points should be taken into consideration:

- Identification of Natural Disaster Risks: Municipalities must first assess the natural disaster risks specific to their states or districts. India is prone to a variety of natural hazards, such as floods, droughts, earthquakes, cyclones, landslides, and heatwaves. Technological disasters, including industrial accidents and chemical spills, must also be considered as part of the disaster management plan.
- Vulnerability Assessment: To assist in developing effective strategies for early warning systems, disaster response, recovery plans, and other preventive measures, municipalities should identify the most vulnerable areas in their states or districts based on local data. For example, flood-prone areas along riverbanks, earthquake-prone zones, or coastal areas susceptible to cyclones should be mapped. Municipalities can collaborate with national agencies like the National Disaster Management Authority (NDMA) for data collection and vulnerability assessments.
- Risk Management Plan: Municipalities should proactively create a comprehensive risk management plan to reduce the impacts of natural disasters. This plan should include an evaluation of existing infrastructure, buildings, and regulations, as well as the strengthening of critical infrastructure such as roads, bridges, and hospitals. Additionally, the plan should outline measures to improve resilience, including enhancing early warning systems, improving evacuation routes, and developing community-based disaster risk management.
- Communication Strategy: A robust communication strategy is essential to inform the public about disaster risks and the appropriate responses. Municipalities should use multiple channels—such as local

radio, television, social media, and community outreach programs—to disseminate warnings about imminent dangers, provide emergency instructions, and offer safety tips during a disaster. Local governments should also ensure that vulnerable populations, including the elderly, differently-abled, and low-income communities, receive timely information in accessible formats.

- Regular Monitoring and Review: Municipalities should regularly monitor and review their disaster risk management plans, communication strategies, and preparedness programs to ensure they are effective and up to date. Regular drills, public awareness campaigns, and updates based on emerging risks and climate change trends should be conducted. Collaboration with national disaster management authorities, local NGOs, and community leaders is crucial for the continuous improvement of disaster response and recovery capabilities.

By focusing on these points, municipalities in India can build a more resilient infrastructure and community, ensuring a coordinated and effective response to natural disasters.

3.2   Use of Artificial Intelligence in Strategic Disaster Management

In recent years, the use of artificial intelligence for various applications and tasks has become increasingly popular. Artificial intelligence is used to automate tasks and improve decision-making, and in this respect, it can have important areas of use in disaster management. Artificial intelligence can be used to predict disasters, provide early warning for disasters, carry out rescue operations, minimize loss of life and property by ensuring faster and more effective management of future disasters, and produce accurate data after disasters. All of these areas of use have advantages and disadvantages in terms of disaster management (Ojukwu et al., 2021).

3.2.1. Areas of Use of Artificial Intelligence in Disaster Prediction and Disaster Preparedness

The areas of use of artificial intelligence in disaster prediction and disaster preparedness can be summarized as follows (Ojukwu et al., 2021; NIST, 2021; Dostal and Helm, 2020; Kotai and Alhaj, 2019):

- Artificial intelligence can be used to analyze past disasters and develop models that predict the magnitude of potential disasters and their impacts on the environment and society. These predictions can be used to inform response plans and better prepare for future disasters.
- AI-based algorithms can be used to analyze data from a variety of sources, including weather data, other natural events, astrological records, and population trends, to predict the likelihood and magnitude of a disaster. For example, by analyzing seismic data, AI can detect changes on the earth's surface before an earthquake occurs and warn people in the area about the impending danger. This analysis is used to create sound disaster warnings, help prepare for potential disasters appropriately, and mitigate the effects of disasters.
- The ability of artificial intelligence to detect subtle changes in data can be used to help detect natural disasters such as floods, hurricanes, and earthquakes. In addition, artificial intelligence can be used to monitor weather patterns and detect changes in air pressure, wind speed, and temperature that may indicate an approaching storm.
- Artificial intelligence can also be used to monitor suspicious activities related to disasters. By combining data from sensors, satellites, drones, and cameras, it is possible to detect changes in the environment that may be signs of a potential disaster through artificial intelligence. This data is also used to send warnings so that authorities can take preventive action. In addition to natural disasters, artificial intelligence, which can be used to predict artificial disasters, is also used to monitor population movements and identify potential terrorist threats. Because artificial intelligence has the ability to detect patterns that may indicate a terrorist plan by analyzing surveillance data from airports, train stations, and other public transportation points.
- AI can also be used to analyze social media posts for evidence of potential threats and to scan keywords related to terrorist activities.
- AI is also used to predict and manage industrial disasters. AI can analyze historical data on industrial accidents and failures to detect anomalies in the data and identify potential risks before a disaster occurs. In addition to all these, AI technologies are also used to monitor industrial processes in real time and identify potential problems before they occur.
- AI applications can also be used by disaster management organizations to design future decisions and actions, and to create timely and accurate post-disaster data. Since AI can analyze existing data, create new data based on these analyses, and help identify trends or patterns that can be used for future planning,

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AI-based management systems are of great importance in strategic disaster management. With this feature, AI can help disaster management organizations make better decisions, prepare for future disasters, and respond efficiently to current disasters.

- Artificial intelligence-supported systems are also used to predict disasters and ensure coordination between stakeholders during disaster preparation.

Application examples of the use of artificial intelligence in this area:

- Weather Forecast: Artificial intelligence has the ability to provide more accurate results compared to traditional calculation methods used in weather forecasts. Artificial intelligence techniques are used to analyze meteorological data used in weather forecasts and to create complex models. For example, IBM's weather forecast platform Watson can make more reliable and accurate weather forecasts using artificial intelligence and machine learning algorithms (IBM, 2021a).
- Earthquake Forecast: In addition to traditional statistical methods used in earthquake forecasts, artificial intelligence has the potential to provide more accurate results by using data mining and machine learning techniques. For example, the US Geological Survey (USGS) has developed an artificial intelligence-based earthquake forecast system called 'ShakeAlert'. This system can make predictions about upcoming earthquakes thanks to real-time analysis of seismic data and machine learning algorithms (USGS, 2021).
- Fire Forecast: Artificial intelligence is also used in the process of predicting and controlling fires. The use of artificial intelligence-based systems is particularly effective in preventing and controlling forest fires. For example, the US Forest Service uses the 'Fire Information for Resource Management System (FIRMS), a system that analyzes images taken from observation satellites with artificial intelligence algorithms. This system is an important tool for predicting and responding to fires (NASA, 2021).
- Flood Forecast: Artificial intelligence is also an effective tool in the development of flood prediction and warning systems. For example, the National Oceanic and Atmospheric Administration (NOAA) and the Indian Meteorological Department have developed the 'Flood Early Warning System (FEWS), an artificial intelligence-based flood prediction system. This system can make predictions about flood formation and spread through real-time analysis of data such as rainfall and water levels (NOAA, 2021).
- Tsunami Forecast: Artificial intelligence is also used in tsunami predictions. For example, the National Research Institute of Japan has developed 'TSUNAMIT', a system that can make real-time tsunami predictions using artificial intelligence algorithms. This system can predict tsunami formation by analyzing earthquake and sea level data (Tsunami Laboratory, 2021).

In summary, in the prediction phase, AI systems can be used to collect and analyze global data to create models that predict the probability or potential severity of a particular disaster event. This information can then be used to create and coordinate an effective response with resources allocated accordingly.

3.2.2. Areas of Use of Artificial Intelligence in the Intervention, Rescue and Recovery Phase

The areas of use of artificial intelligence in the intervention, rescue and recovery phase can be summarized as follows (Singh and Singh, 2021; Sharma and Dhir, 2021; Chen and Guo, 2020; Shrestha et al., 2020; Liu et al., 2020; Subedi and Chintalapudi, 2020; Özcan, 2019, Sezer et al., 2014; Özkan and Bozkurt, 2018; Turk et al., 2016):

- AI-based search and rescue robots can be used to locate and detect survivors, as well as for interventions in difficult terrains that are too dangerous for humans to enter. AI-driven systems can help automate the search and rescue process by using sensors and AI-supported robots to quickly search large areas for disaster victims.
- In the response phase, AI can help alleviate some of the burden on emergency response teams by automating certain processes. For example, intelligent robots can be used to rescue personnel from dangerous tasks such as debris removal and tasks that require physical interaction with hazardous materials. AI-based facial recognition systems can also be used to quickly scan individuals for identity verification and identification, and in some cases, to verify eligibility for assistance.
- AI can also be used to monitor and guide evacuations and track resource flow.
- In addition to providing telemedicine services, AI technologies can also be used to provide medical assistance in disasters, such as diagnosing and treating victims.

- AI-based algorithms can detect patterns in data that indicate which areas need assistance the most and help create a response plan to ensure that assistance reaches the most vulnerable populations as quickly as possible. Therefore, AI can help allocate scarce resources effectively for disasters.
- AI-powered systems can help assess damage, prioritize repairs, and monitor the progress of the reconstruction process. AI can be used to analyze data from sensors and satellites that provide information about the environment and conditions. This data can help identify the most affected areas and the level of damage that has occurred. This information can then be used to direct relief efforts, prioritize interventions, and identify areas at risk of further damage.
- AI can also be used to analyze data from social media platforms, creating indicators and sources of verification of the behavior and emotions of people in affected areas. This data helps determine the size of the affected population and the level of resources needed.
- AI systems can also be used to detect hazardous substances, such as chemicals or radiation. This detection helps identify unsafe areas and allows first responders to focus their efforts elsewhere.
- AI systems can also be used to quickly assess the damage to a home or building and help accurately assess repair costs.
- AI systems can also be used to provide automated answers to common questions that survivors may ask. This rapid response system helps relieve the stress of an already difficult situation and speed up survivors' access to the resources they need.
- An AI-supported system can also be used to coordinate stakeholders in disaster response, disaster recovery, and recovery.

Examples of applications for the use of AI in this area:
- Artificial Intelligence in Disaster Reporting and Forecasting: Artificial intelligence plays a very important role in the process of predicting and reporting disasters. The Global Crisis Map, developed by Google, analyzes real-time data about natural disasters and man-made events using artificial intelligence algorithms and helps users learn about the events (URL 1).
- Artificial Intelligence in Emergency Management: In the emergency management process, it is very important to rescue people quickly and deliver aid quickly. Artificial intelligence plays a major role in the search and rescue techniques and strategies used in this process. The Nebula Platform, developed by NASA, uses artificial intelligence algorithms to coordinate rapid flight and rescue activities in disaster areas (NASA, 2018).
- Artificial Intelligence in Casualty Detection: During disasters, it is vital to detect casualties and direct medical teams to the right places. Artificial intelligence can help detect casualties by analyzing visual data. In a study funded by the US National Science Foundation, images obtained from drones were used to detect injured people through artificial intelligence algorithms (National Science Foundation, 2019).
- Artificial Intelligence in Data Analysis: It is important to make accurate and timely decisions to provide assistance to people after disasters. Artificial intelligence can help determine the needs of regions and where assistance is needed by analyzing large data sets. The Watson System developed by IBM is used for big data analysis in emergency management (IBM, 2019).
- Artificial Intelligence in Unmanned Vehicles: Unmanned vehicles are used to ensure the safety of people in disaster areas. Artificial intelligence helps these vehicles move more intelligently and safely. The robot named Spot, developed by Boston Dynamics, uses artificial intelligence algorithms to assist rescue teams in disaster areas (Boston Dynamics, 2021).

Local governments in India also play an active role in disaster management and aim to enhance their disaster management processes by leveraging various information systems and artificial intelligence (AI) technologies. Information systems enable the collection, analysis, storage, and sharing of data before, during, and after a disaster. These systems are crucial in predicting potential disaster impacts and conducting risk analyses. They also play a key role in monitoring ongoing events and coordinating rescue efforts during a disaster.

AI technologies are used to analyze large data sets, predict disasters, and assess risks before and during a disaster. Additionally, technologies like smart sensors and image analysis provide fast and accurate information about the conditions of regions and infrastructure affected by disasters. By using these technologies, local governments can manage disaster processes more effectively and intervene quickly when necessary.

For instance, conducting pre-disaster risk assessments can help identify high-risk areas, enabling municipalities to create evacuation plans and preparedness strategies. During a disaster, data collection can be automated using smart sensor systems and AI, allowing emergency response teams to receive faster and more precise information. Furthermore, by utilizing information systems and AI in disaster management, local governments can take preventive actions. Based on the data from disaster simulations and risk assessments, municipalities can take measures like strengthening vulnerable structures or relocating populations at risk.

Here are some relevant examples of how local governments in India are using information systems and AI in disaster management:

- Flood Hazard Monitoring and Early Warning System (FHMEWS): This AI-based system is used by local governments in flood-prone regions of India. It analyzes key data such as rainfall estimates, river water levels, and weather patterns to predict flood risks and provide early warnings. This helps in implementing preventive measures and facilitating rapid interventions during floods. The system enables better preparedness by forecasting the scale of the floods and the areas that need immediate attention.
- Smart City and Urban Disaster Management Initiatives: Various Indian cities have implemented smart city technologies that integrate AI and data systems to enhance disaster preparedness. For example, cities like Ahmedabad and Pune use AI for early warning systems, traffic management during evacuations, and monitoring of environmental risks like air pollution, heatwaves, and floods.
- National Disaster Management Authority (NDMA) Initiatives: NDMA has launched several initiatives, including GIS-based platforms, to support local governments in disaster preparedness. These platforms provide real-time data on disaster risks and help local authorities to manage the response and recovery processes efficiently. Local governments use these tools to identify high-risk areas, plan evacuations, and coordinate resources during disasters.

These examples demonstrate how information systems and AI technologies are playing a significant role in disaster management in India. By integrating these technologies, local governments can minimize the impacts of disasters, facilitate faster and more accurate interventions, and improve their overall disaster management capabilities.

Through such advancements, local governments in India can better manage disaster response, ensure timely interventions, and reduce vulnerabilities in disaster-prone areas, thereby improving the resilience of communities across the country.

3.2.3. Advantages of Using Artificial Intelligence in Strategic Disaster Management
The advantages of using artificial intelligence in strategic disaster management can be classified under three headings:

- Improved Risk Assessment: With artificial intelligence, it is possible to accurately estimate the possible scope of a disaster and related risks. This opportunity can help decision makers allocate resources better and prioritize urgent and necessary tasks to reduce risks and mitigate damages. Artificial intelligence systems that can be used to plan evacuations or aid efforts in advance also have the qualities that can contribute to a better understanding of the situation and geography of the region affected by the disaster (Sümer, 2019; Özkan and Yüksel, 2017).
- Improved Response Times: Artificial intelligence-supported technologies have the qualities that can contribute to the establishment of a technological system where autonomous robots can be developed to rapidly assess disaster areas and provide on-site situational awareness by being used to respond to disasters rapidly. In addition to all these, it is possible to use this technology to analyze information from sources such as satellite images and social media, to evaluate the situation after disasters, and to reveal the effects of population and geographic size on this situation. This information can then be used to direct disaster relief efforts and greatly reduce the time required to mobilize resources (Konak and Akdemir, 2019; Çelik and İnci, 2018).
- Improved Communication: Artificial intelligence technology also has the potential to accelerate disaster response efforts by automating communication between stakeholders. For example, artificial intelligence technologies need to be used to convey critical information to the relevant personnel quickly and when necessary, to follow the change and deliver up-to-date information to the relevant parties, thus establishing an advanced communication and coordination flow (Sun et al. 2020).

3.2.4. Disadvantages of Using Artificial Intelligence in Strategic Disaster Management

There are several disadvantages of using artificial intelligence in strategic disaster management (Gürgen and Aşkın, 2020; Seaberg et al., 2017):

- Artificial intelligence is highly dependent on data. Therefore, all artificial intelligence systems used to manage disasters must have access to high-quality data. This requirement poses a significant risk area, especially in natural disaster situations, as it makes the acquisition and verification of data more costly and time-consuming. In addition, data-based models support the formation of bias by causing certain types of data to gain weight due to the prevalence of these data, and can reduce the impact of artificial intelligence technologies.

- Systems related to artificial intelligence technologies work with a very complex infrastructure. The algorithms and techniques used in the applications of this technology are generally too complex to be understood and controlled by the average person. This complexity and difficulty can lead to wrong decisions and unexpected results, especially when dealing with emergencies.

- It is often difficult to monitor AI applications when there is a problem and to detect the results they produce. This can make it difficult to detect when the AI system has failed or produced incorrect results.

- AI applications are not infallible. Even with the best data and algorithms, errors can be made that can lead to incorrect results. These errors can include decisions based on incorrect information or inappropriate responses to disasters.

- These systems may not have sufficient defences against cyberattacks that can cause larger-scale damage.

In general, research and development of AI for disaster management is ongoing, and since the use of this system has its own risks and drawbacks, in order to ensure that AI systems provide the most accurate and useful results, it is possible to prepare an appropriate strategic management model after correctly evaluating the advantages and disadvantages of AI use in strategic disaster management and taking measures to reduce or eliminate the disadvantages.

4.   CONCLUSION

Disasters are becoming increasingly common and affecting communities all over the world. Governments and emergency response teams struggle to find and help those in need while using available resources, and despite spending significant effort and resources in the face of these crises, they often face serious challenges in disaster management. In combating these challenges, advances in artificial intelligence technology offer a unique opportunity to improve and optimize disaster management. In addition to these opportunities, an AI-supported strategic management model that will be developed by analyzing the risks inherent in artificial intelligence technologies will contribute to its stakeholders at a very high level. In general, the use of AI in strategic disaster management has tremendous potential to improve the quality of life of people in disaster-prone areas. Recent advances in AI have the potential to help machines accurately predict many different types of disasters, from natural disasters to terrorist attacks. AI can help predict disasters by detecting subtle changes in data, as well as identifying and analyzing valuable information that will help decision-makers prepare for and respond to such events. AI can also help direct relief efforts, prioritize intervention, and identify areas at risk of further damage by analyzing data from sensors and social media. In addition, AI is a valuable tool for disaster response, with the ability to assist first responders, identify aid to be provided to survivors, quickly analyze data, and provide appropriate support based on analysis results. As a result, AI has the ability to play an important role both before and after a disaster. Therefore, as AI technology continues to develop and gain wider adoption, its applications in disaster management are likely to become even more powerful and widespread. The potential applications of AI in disaster management are limited by the data and the imagination of the people using it. As the technology continues to evolve, more and more governments and organizations will begin to use AI as part of their strategic plans for disaster management. AI-enhanced management systems can help minimize the impact of disasters and save lives by increasing the speed and efficiency of disaster response. However, AI also presents certain challenges and risks that must be carefully evaluated and managed. Ultimately, when used responsibly and in consultation with ethical experts and emergency management specialists, AI can prove to be an invaluable tool in disaster response. For this to happen, the number of scientific studies in this area needs to be increased.

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[Ghori* *et al.,* **10(10): October, 2021]**
IC™ Value: 3.00

ISSN: 2277-9655
Impact Factor: 5.164
CODEN: IJESS7

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