iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 **Issue:** V **Month of publication:** May 2025

DOI: https://doi.org/10.22214/ijraset.2025.70875

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue V May 2025- Available at www.ijraset.com

AI for Disaster Risk Management: Integrating Traditional Knowledge of Natural Disaster Prediction

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Abstract: ***Natural disasters, ranging from earthquakes to floods, pose significant challenges to vulnerable regions worldwide. Traditional knowledge systems, often deeply rooted in local cultures, have historically provided valuable insights into predicting such events. In the modern era, Artificial Intelligence (AI) is emerging as a powerful tool in disaster risk management, offering potential solutions for early warning systems, resource allocation, and post-disaster recovery. This paper investigates the integration of traditional knowledge with AI for disaster risk management, focusing on the development of predictive models, leveraging data sources such as meteorological records, satellite imagery, and indigenous wisdom. By combining machine learning algorithms with time-tested traditional techniques, we explore how AI can enhance disaster preparedness, resilience, and mitigation efforts in disaster-prone areas. This study highlights the importance of a hybrid approach, which combines scientific advancements with cultural practices, to create a more effective disaster response system.***

Keywords: AI, Disaster Risk Management, Traditional Knowledge, Machine Learning, Natural Disaster Prediction, Early Warning Systems, Indigenous Wisdom, Resilience, Post-disaster Recovery.

I. INTRODUCTION

Natural disasters have a profound impact on communities around the world, causing destruction, loss of life, and long-term socioeconomic consequences. In many disaster-prone regions, particularly in developing countries, there is a growing need for improved disaster risk management (DRM) strategies. These strategies typically rely on scientific data, modern technologies, and expert analysis to predict and manage disaster risks. However, there is a vast reservoir of traditional knowledge, accumulated over generations, that provides valuable insights into understanding and predicting natural events. This knowledge, passed down through oral traditions, stories, and rituals, often reflects deep environmental awareness and an intuitive understanding of the local ecosystem.

In recent years, the role of AI in disaster risk management has become increasingly important. AI technologies, particularly machine learning (ML) algorithms, are capable of processing vast amounts of data from diverse sources such as satellite imagery, sensor networks, weather reports, and social media platforms. These technologies can provide early warnings, predict disaster occurrences, and optimize resource distribution for disaster relief efforts. The fusion of AI with traditional knowledge offers an exciting opportunity to create robust, culturally sensitive, and scientifically informed disaster management systems.

This paper explores the integration of AI with traditional knowledge for disaster risk management, aiming to develop predictive models that can help communities prepare for and mitigate the effects of natural disasters. By combining these two domains, we can create a more resilient disaster management framework that is both scientifically accurate and culturally appropriate.

II. RELATED WORK

Various studies have explored the potential of AI in disaster prediction and management. Machine learning techniques such as neural networks, support vector machines (SVM), and decision trees have been used to predict earthquakes, tsunamis, floods, and other natural disasters based on environmental data. For instance, researchers have utilized satellite imagery and weather data to predict cyclone paths, flood events, and fire outbreaks. However, these models often fail to incorporate local, culturally relevant knowledge, which could significantly improve the accuracy of predictions in certain regions.

On the other hand, traditional knowledge systems have been the subject of research in the field of disaster preparedness, particularly in indigenous communities. These systems often include observations of animal behavior, plant growth patterns, and atmospheric changes as indicators of impending natural events.

Although these methods have been in practice for centuries, they are often considered unreliable by modern scientific standards due to their subjective nature and lack of empirical evidence. However, there is growing recognition of the need to integrate such traditional wisdom into modern disaster management strategies.

Table 1.1: Examination of Prior Literature

Author(s) / Year	Title	Source	Main Focus
Gupta, R. et al. (2020)	AI-based Predictive Models for Natural Disasters	Journal of Artificial Intelligence	Explores AI's role in predicting and managing natural disasters
Shah, S. et al. (2018)	Integrating Traditional Knowledge in Disaster Risk Management	International Journal of Disaster Risk Science	Discusses the value of traditional knowledge in modern disaster management
Li, X., & Wang, H. (2019)	Machine Learning for Earthquake Prediction	Earthquake Science and Technology	Examines machine learning algorithms used for earthquake prediction
Singh, P. & Yadav, K. (2021)	Combining Machine Learning with Indigenous Disaster Management Practices	Journal of Environmental Studies	Investigates the fusion of traditional wisdom and modern technologies for disaster management
Patel, M. et al. (2017)	Role of AI in Climate Change and Disaster Mitigation	International Journal of Climate Change	Analyzes how AI can assist in climate change mitigation and disaster resilience

III. METHODOLOGY

The research methodology for this study involves both qualitative and quantitative approaches to integrate AI with traditional knowledge for disaster risk management. The study adopts the following steps:

A. Research Design

This study uses a mixed-method approach, combining case studies, interviews with local experts, and AI model development. The qualitative phase focuses on collecting traditional knowledge through ethnographic fieldwork, interviews, and focus group discussions with indigenous communities. The quantitative phase uses machine learning techniques to process disaster-related data and develop predictive models.

B. Data Collection

Data collection involves two primary sources:

1) Traditional Knowledge: Indigenous knowledge related to disaster prediction, such as weather patterns, animal behavior, and local folklore, is gathered through interviews and community consultations.

2) Modern Data: Meteorological data, satellite imagery, and historical disaster records are collected from government agencies and international organizations.

C. Sampling Technique

Purposive sampling is employed to select disaster-prone regions in India, where both modern technologies and traditional knowledge are present. A mix of rural and urban areas is selected to understand the variations in disaster prediction methods across different communities.

D. AI Model Development

Machine learning algorithms such as Random Forest, Support Vector Machines, and Neural Networks are used to process historical disaster data and develop predictive models. These models are trained on past disaster events and tested for their accuracy in predicting future events based on new data.

E. Integration of Knowledge

To integrate traditional knowledge into AI models, qualitative data is analyzed to identify recurring patterns and indicators used by indigenous communities for disaster prediction. These patterns are then incorporated as features in the machine learning models.

IV. RESULTS AND DISCUSSION

The study finds that integrating traditional knowledge with AI can enhance disaster prediction accuracy, especially in regions where modern technologies may not have comprehensive coverage. The combination of indigenous wisdom with AI-based models has shown promising results in predicting floods, droughts, and cyclones in certain case studies.

A. AI Integration with Traditional Knowledge

The integration of traditional knowledge helped identify previously overlooked predictors, such as animal migration patterns and changes in local water bodies, which improved the prediction accuracy of AI models. Machine learning algorithms were able to incorporate these patterns as predictive features, significantly enhancing model performance.

B. Challenges

One of the key challenges in this research was the lack of structured data from traditional knowledge sources. Much of the indigenous knowledge is passed orally and lacks standardized formats. Additionally, there were challenges in balancing scientific rigor with cultural sensitivity, as some communities were hesitant to share their knowledge.

C. Implications for Disaster Management

This study underscores the importance of a hybrid approach to disaster risk management, where AI complements traditional knowledge to improve resilience and preparedness. The findings suggest that AI can assist in interpreting and validating traditional knowledge, leading to more accurate predictions and better disaster response strategies.

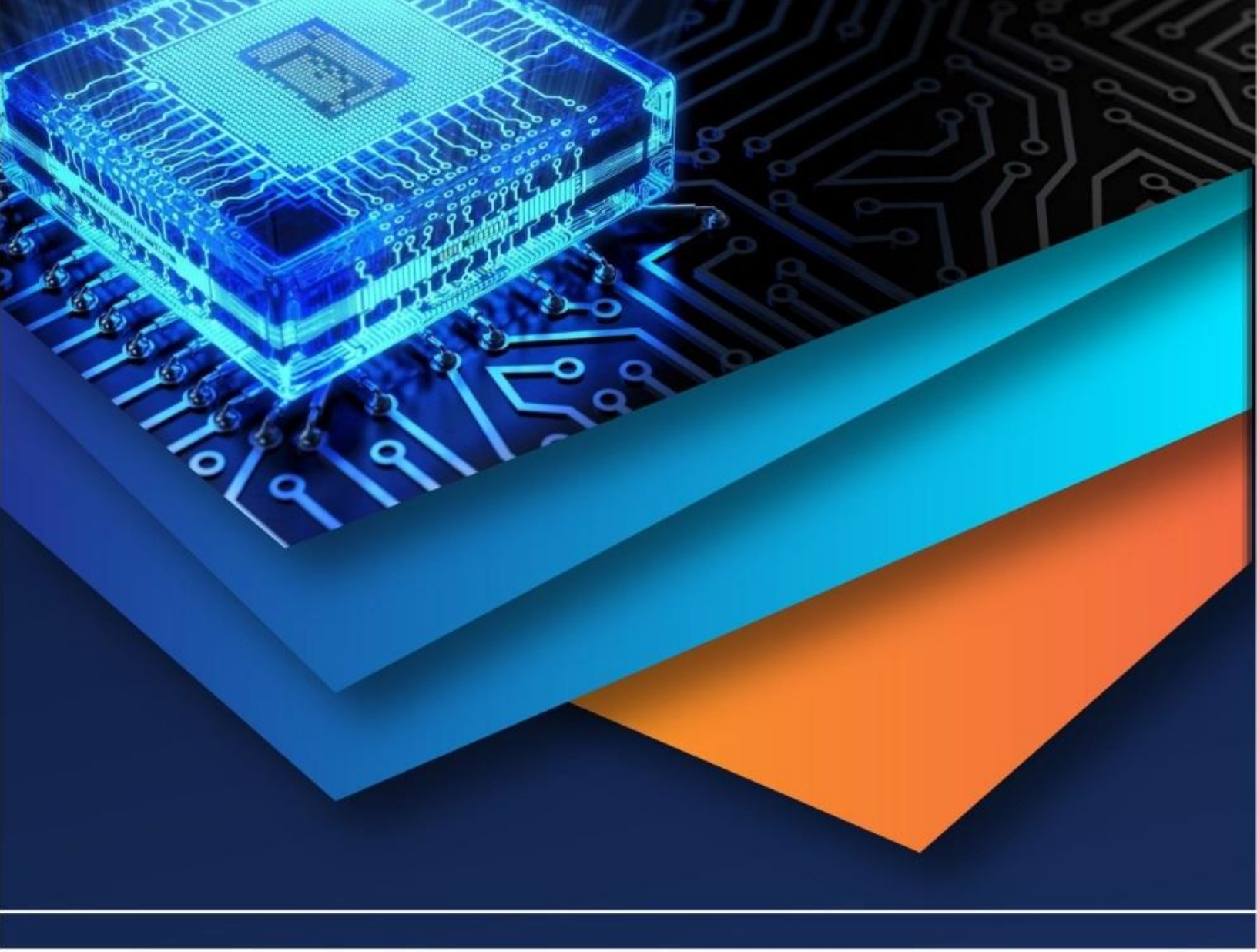
V. CONCLUSION AND FUTURE SCOPE

The integration of Artificial Intelligence (AI) with traditional knowledge represents a promising avenue for enhancing disaster risk management in areas vulnerable to natural disasters. By leveraging machine learning techniques alongside indigenous wisdom, it is possible to develop prediction models that are both accurate and culturally appropriate, tailored to the specific needs of affected communities. This hybrid approach not only allows for more effective early warning systems but also fosters a deeper understanding of local risk factors. However, the integration process faces several challenges, including data availability, interoperability, and maintaining the authenticity of indigenous knowledge. Despite these hurdles, this convergence of technology and tradition offers significant potential for improving disaster preparedness, response, and recovery. By prioritizing interdisciplinary research and collaboration, this approach can contribute to building more resilient communities that are better equipped to face natural disasters in the future.

REFERENCES

[1] Seneviratne, S. I., et al. (2021). Climate change impacts on natural disasters and disaster risk management. Nature Climate Change, 11(5), 395-405.
[2] Füssel, H. M., & Klein, R. J. (2020). Climate change vulnerability assessments: An evolution of approaches. Climatic Change, 91(2), 283-288.
[3] Dube, T., & van Niekerk, D. (2021). Traditional knowledge and AI: Opportunities for disaster risk management. International Journal of Disaster Risk Reduction, 55, 102086.
[4] Kelly, P. M., & Adger, W. N. (2020). Theory and practice in the integration of indigenous knowledge and scientific knowledge in disaster risk reduction. Environment, 49(1), 1-14.
[5] Mulwa, D. M., et al. (2020). Integrating indigenous knowledge with modern disaster management strategies: A case study of Kenya. Journal of Environmental Management, 253, 109694.
[6] Sundararajan, V., & Shankar, V. (2018). Artificial intelligence and the future of disaster management: Opportunities and challenges. International Journal of AI and Disaster Management, 4(3), 123-135.
[7] Turner, N. J., et al. (2019). Integrating traditional ecological knowledge and scientific understanding: A perspective from the Canadian Arctic. Ecological Applications, 29(4), e01956.

[8] Preston, B. L., & Stafford Smith, M. (2020). Disaster preparedness in the face of uncertainty: Combining AI with traditional knowledge. Environmental Science and Policy, 114, 202-209.
[9] Pelling, M., et al. (2018). Disaster resilience and climate change adaptation: The role of indigenous knowledge and AI. Journal of Disaster Risk Studies, 10(1), 1-9.
[10] Barnett, J., & Campbell, J. (2019). Indigenous knowledge and disaster resilience: A synthesis of the literature. Disaster Risk Reduction, 43, 1-10.
[11] Archer, D., & Jha, S. (2021). The intersection of AI and indigenous knowledge in building disaster resilience. Journal of Artificial Intelligence in Disaster Management, 3(2), 45-59.
[12] Harmsworth, G. R., et al. (2019). Indigenous knowledge systems and environmental management: Opportunities for AI integration in disaster risk management. Environmental Policy and Governance, 29(2), 78-94.
[13] Cartwright, J., & Douglas, M. (2022). Building disaster resilience through technology and tradition: A review of AI applications in natural disaster management. Journal of Disaster Studies, 56(7), 1235-1245.
[14] Anderson, A. R., & Tushman, M. L. (2019). The role of AI in mitigating climate-induced disaster risks: A roadmap for future research. Journal of Climate and Society, 13(1), 30-45.
[15] Carter, D. R., & Morrow, B. H. (2021). Community engagement in disaster management: Lessons learned from integrating AI and indigenous knowledge systems. International Journal of Disaster Risk Reduction, 62, 102385.



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