Disaster Risk Management: Using Artificial Intelligence to Improve Early Warnings, Damage Assessment, Resource Allocation and Long-term Resilience

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Abstract

This paper examines how Artificial Intelligence (AI) can be harnessed to strengthen disaster risk management. The paper observes that AI provides viable solutions towards harnessing the power of technology for effective disaster risk management. It discusses how AI can strengthen disaster risk management strategies and policies towards Sustainable Development. In addition, the paper also examines the risks and challenges associated with the use of AI in disaster risk management. In light of its benefits and risks, the paper proposes how AI can be appropriately utilised to improve early warnings, damage assessment, resource allocation and long-term resilience towards effective disaster risk management for Sustainable Development.

1.0 Introduction

With the world facing numerous and mounting disasters, effective disaster risk management is vital in protecting people and planet towards Sustainable Development. Disasters are natural or human-induced events which cause serious disruption to the functioning of a community, society or nation leading to widespread human, material, economic or environmental losses which exceed the ability of the affected community, society or nation to cope using their own resources[1]. It has been observed that disasters can be human-made or natural[2]. Human-made disasters result from human errors and include industrial explosions, structure failures, acts of terrorism, and incidents of mass violence[3]. Natural disasters on the other hand result from physical phenomena and include earthquakes, severe storms and floods, wildfires, and droughts[4].

It has been observed that disasters in whatever form disrupt communities and can take a serious toll on people, property, economies, and the environment[5]. The United Nations observes that the prevalence of disasters globally is a growing threat to economic prosperity and Sustainable

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[1] Republic of Kenya., 'National Disaster Risk Management Policy' Available at https://repository.kippra.or.ke/xmlui/bitstream/handle/123456789/559/NATIONAL%20Disaster%20Risk%20Mannagement%20POLICY%20APPROVED.pdf?sequence=1&isAllowed=y (Accessed on 30/04/2026)

[2] What is Disaster Management? Understanding Emergencies from Prevention to Mitigation., Available at https://publichealth.tulane.edu/blog/what-is-disaster-management/ (Accessed on 30/04/2026)

[3] Ibid

[4] Ibid

[5] Ibid

Development, with costs underestimated and unsustainable[6]. For example, the loss of life, livelihoods, infrastructure and social amenities due to disasters is pushing countries into increased levels of debt, lower incomes and severe humanitarian crises[7]. It has been observed that most disasters often stretch a community's capacity to cope leading to serious economic and social costs[8]. Consequently, disasters leave vulnerable populations at the risk of famine, food insecurity and poverty undermining Sustainable Development[9]. In addition, environmental degradation due to disasters also lead to displacement of populations leading to humanitarian crises including increase in the number of refugees and internally displaced persons[10].

Due to the prevalence and profound impact of disasters on people and planet, effective disaster risk management is vital in fostering Sustainable Development. Disaster risk management refers to the application of disaster risk reduction policies and strategies to prevent new disaster risk, reduce existing disaster risk and manage residual risk, contributing to the strengthening of resilience and reduction of disaster losses[11]. Disaster risk reduction is a concept and practice of reducing disaster risks through systematic efforts to analyse and reduce the causal factors of disasters[12]. This concept aims at preventing new and reducing existing disaster risk and managing residual risk, all of which contribute to strengthening resilience and therefore to the achievement of Sustainable Development[13]. Disaster risk management is therefore key in ensuring the implementation of disaster risk reduction policies for Sustainable Development[14].

This paper examines how Artificial Intelligence (AI) can be harnessed to strengthen disaster risk management. The paper observes that AI provides viable solutions towards harnessing the power of technology for effective disaster risk management. It discusses how AI can strengthen disaster risk management strategies and policies towards Sustainable Development. In addition, the paper also examines the risks and challenges associated with the use of AI in disaster risk management.

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[6] United Nations., 'International Day for Disaster Risk Reduction' Available at https://www.un.org/en/observances/disaster-reduction-day (Accessed on 30/04/2026)

[7] Ibid

[8] What is Disaster Management? Understanding Emergencies from Prevention to Mitigation., Op Cit

[9] United Nations Office for Disaster Risk Reduction., 'Building Disaster Resilience in Sub-Saharan Africa' Available at https://www.preventionweb.net/resilient-africa/home.html (Accessed on 30/04/2026)

[10] East African Community., 'Disaster Risk Reduction and Management' Available at https://www.eac.int/gender/114-sector/environment-natural-resources-management/disaster-risk-reduction (Accessed on 30/04/2026)

[11] United Nations Office for Disaster Risk Reduction., 'Definition: Disaster Risk Management' Available at https://www.undrr.org/terminology/disaster-risk-management#:~:text=Disaster%20risk%20management%20plans%20set,actions%20to%20accomplish%20these%20objectives. (Accessed on 30/04/2026)

[12] United Nations Educational, Scientific and Cultural Organanization., 'Disaster Risk Reduction' Available at https://www.unesco.org/en/disaster-risk-reduction (Accessed on 30/04/2026)

[13] United Nations Office for Disaster Risk Reduction., 'Definition: Disaster Risk Reduction' Available at https://www.undrr.org/terminology/disaster-risk-reduction#:~:text=Disaster%20risk%20reduction%20is%20aimed,the%20achievement%20of%20sustainable%20development. (Accessed on 30/04/2026)

[14] United Nations Office for Disaster Risk Reduction., 'Definition: Disaster Risk Management' Op Cit

In light of its benefits and risks, the paper proposes how AI can be appropriately utilised to improve early warnings, damage assessment, resource allocation and long-term resilience towards effective disaster risk management for Sustainable Development.

2.0 Role of Artificial Intelligence in Disaster Risk Management

In an era marked by mounting and unprecedented disasters, AI has emerged as a powerful tool that is strengthening anticipation, response and recovery[15]. For instance, it has been observed that the predictive capacity of AI has led to advancements in forecasting meteorological, hydrological, and geological hazards and disasters for effective and timely responses[16]. In particular, the integration of AI into early warning systems is advancing monitoring and forecasting capabilities, optimizing warning dissemination and communication so that important information reaches people at risk of disasters in time for them to act and avoid the worst impact of disasters such as severe storms, floods and landslides[17]. It has been pointed out that AI can analyze huge volumes of climate data thus tailoring and translating warnings to specific contexts and enhancing access to climate information on the basis of geography, gender, or vulnerability[18]. By strengthening early warning systems, AI sharpens hazard forecasts and ensures access to population-specific alerts in near real time[19].

In addition, AI can optimize damage assessment and resource allocation thus enabling better responses and recovery from disasters[20]. For example, it has been observed that by integrating data from satellite imagery, social media and administrative records, AI enables the production of more rapid and comprehensive damage and needs assessments[21]. This strengthens damage assessment through effective identification of the number of people displaced or affected by disasters and the type and location of infrastructure damaged due to disasters[22]. It has been pointed out that AI accelerates the damage assessment process in the wake of disasters, allowing

[15] Artificial Intelligence (AI) for Disaster Risk Reduction., Available at https://www.preventionweb.net/collections/artificial-intelligence-ai-disaster-risk-reduction (Accessed on 30/04/2026)
[16] Ibid
[17] Enhancing Early Warning Systems with Artificial Intelligence., Available at https://www.itu.int/itu-d/sites/digital-impact-unlocked/enhancing-early-warning-systems-with-artificial-intelligence/ (Accessed on 30/04/2026)
[18] Artificial Intelligence and Early Warning Systems: Promise, Peril, and the Path Forward., Available at https://www.early-action-reap.org/blog/artificial-intelligence-and-early-warning-systems-promise-peril-and-path-forward (Accessed on 30/04/2026)
[19] United Nations Office for Disaster Risk Reduction., 'Global: AI-powered early-warning systems under the Early Warnings for All (EW4All) initiative' Available at https://www.undrr.org/resource/case-study/global-ai-powered-early-warning-systems-under-early-warnings-all-ew4all (Accessed on 30/04/2026)
[20] Organisation for Economic Co-operation and Development., 'AI in Law Enforcement and Disaster Risk Management' Available at https://www.oecd.org/en/publications/governing-with-artificial-intelligence_795de142-en/full-report/ai-in-law-enforcement-and-disaster-risk-management_99fc1804.html (Accessed on 30/04/2026)
[21] Organisation for Economic Co-operation and Development., 'AI in Law Enforcement and Disaster Risk Management' Op Cit
[22] Ibid

recovery efforts to begin as soon as possible[23]. In addition, by strengthening damage assessment, AI enables decision-makers to determine the most vulnerable populations and prioritise recovery projects thus ensuring effective and efficient resource allocation[24]. It has been observed that AI tools including satellite imagery and remote sensing are automating damage assessments and resource allocation by turning raw data into clear and focused recovery plans and policies[25].

AI tools can also enable individuals, communities and nations to build long-term resilience to disasters. For instance, it has been observed that by mapping historical hotspots of disasters including past flooding events or earthquakes, AI helps to inform the allocation of disaster risk reduction investments to where they are needed most, reducing human, economic and environmental losses and building the long-term resilience of vulnerable populations to disasters[26]. AI tools can model different recovery scenarios therefore enabling decision-makers to rebuild infrastructure, restore livelihoods and enhance long-term resilience to disasters[27].

Harnessing AI is therefore vital for effective disaster risk management. It has been argued that with its potential to enhance prediction, response, and recovery efforts, AI provides effective solutions that can bolster disaster risk management[28]. In particular, it has been observed that AI-driven models are increasingly proving successful for earthquake and flood monitoring enhancing anticipation, response and recovery to these among other disasters[29]. AI tools can analyze satellite imagery, drone footage, social media posts, and ground sensors to warn individuals and communities against impending disasters, assess the damage caused by disasters, prioritize rescue zones, ensure effective allocation of resources, and optimize logistics[30]. In addition, AI plays an important role in analyzing historical disaster data, infrastructure weaknesses, and socio-economic vulnerabilities thus strengthening future mitigation and long-term resilience[31].

Despite its benefits, the use of AI in disaster risk management raises several risks and challenges. For instance, it has been observed that the effectiveness, accuracy and appropriateness of AI

[23] Ibid
[24] Ibid
[25] Artificial Intelligence (AI) for Disaster Risk Reduction., Op Cit
[26] United Nations Office for Disaster Risk Reduction., 'Guiding Disaster Risk Reduction Investments through AI powered tools' Available at https://iddrr.undrr.org/news/guiding-disaster-risk-reduction-investments-through-ai-powered-tools-0 (Accessed on 30/04/2026)
[27] Organisation for Economic Co-operation and Development., 'AI in Law Enforcement and Disaster Risk Management' Op Cit

[28] Unlocking Solutions: AI for Disaster Management and Psychosocial Well-Being., Available at https://unu.edu/cris/blog-post/unlocking-solutions-ai-disaster-management-and-psychosocial-well-being (Accessed on 30/04/2026)
[29] Ibid
[30] Can AI be a Game changer to reduce casualties from natural disasters?., Available at https://sdg-action.org/can-ai-be-a-gamechanger-to-reduce-casualties-from-natural-disasters/ (Accessed on 30/04/2026)
[31] Ibid

models depend on the information they are built on[32]. Thus, in the context of disasters whereby most of them are rare, sudden and unexpected, the amount and quality of data available for training AI systems is limited hindering effective disaster risk management[33]. In addition, it has been observed that although disasters happen all over the world, their impacts are felt unevenly across communities, nations and regions[34]. According to the United Nations, disasters are linked to inequalities with developing countries, the poor and vulnerable communities being hit the hardest due to lack of sufficient resources to protect themselves and recover from the impacts of disasters[35]. It has been observed that unequal access to resources and services leaves the most vulnerable exposed to the danger of disasters while the effects of disasters exacerbate inequalities and push the most at risk further into poverty[36]. This situation is worsened by the digital divide with developed countries harnessing AI and other modern technologies towards strengthening their disaster risk management capacity while developing countries face challenges in adopting AI and other technologies leaving them extremely vulnerable to disasters[37]. For example, it has been observed that developed countries have invested heavily in digital infrastructure, meteorological monitoring, communications networks, and rapid deployment capabilities translating into more effective early warning systems and disaster response and recovery policies[38]. On the other hand, developing countries face resource constraints, less robust data systems, weaker connectivity, poor digital infrastructure and limited emergency logistics thus leaving them extremely vulnerable when disasters strike[39]. Bridging the digital divide between developed and developing countries is therefore important towards strengthening disaster risk management all over the world.

3.0 Using Artificial Intelligence to Improve Early Warnings, Damage Assessment, Resource Allocation and Long-term Resilience

With disasters devastating people and planet, effective disaster risk management is a key global priority towards Sustainable Development. Countries all over the world are facing increasingly severe natural events and disasters driven by extreme weather and risk-blind planning[40]. Disasters fuel the loss of human life, destruction of vital infrastructure, loss of livelihoods and environmental damage thus undermining Sustainable Development[41]. Consequently, it has been observed that

[32] Unlocking Solutions: AI for Disaster Management and Psychosocial Well-Being., Op Cit
[33] Ibid
[34] United Nations., 'International Day for Disaster Risk Reduction' Op Cit
[35] Ibid
[36] United Nations., 'Fighting Inequality for a Resilient Future' Available at https://www.un.org/en/observances/disaster-reduction-day (Accessed on 30/04/2026)
[37] Can AI be a Game changer to reduce casualties from natural disasters?., Op Cit
[38] Ibid
[39] Ibid
[40] United Nations., 'International Day for Disaster Risk Reduction' Op Cit
[41] Ibid

sound disaster risk management policies and plans are necessary in order to lessen the impacts of disasters by minimising losses of life and property and damage to the environment[42].

AI provides vital solutions towards bolstering disaster risk management. For example, AI can improve early warnings, damage assessment, resource allocation and long-term resilience thus enhancing the capacity of individuals, communities, nations and the world at large to anticipate, respond to and recover from disasters[43]. AI tools and systems including machine learning can strengthen disaster risk management by forecasting extreme events and natural disasters including floods, earthquakes and landslides thus enabling the world to effectively manage the impacts of such disasters[44].

However, in light of challenges such as availability and quality of data and digital divide between developed and developing countries, it is imperative to appropriately harness AI in order to strengthen disaster risk management all over the world. In order to achieve this goal, it is imperative to train AI systems on accurate, sufficient and quality environmental data[45]. It has been observed that in the context of disaster risk management through AI, the possible costs of failing to provide appropriate and quality data can be adverse since this can result in wrong predictions or biased outcomes with adverse effects on people and planet[46].

In addition, it is imperative to strengthen investments in AI and other modern technologies especially in the Global South in order bolster the disaster risk management capacity of developing countries. The Global South is extremely vulnerable to disasters. For instance, it has been observed that due to its geographic location and low level of technological development, Africa remains highly vulnerable to disasters which usually appear in the form of climate related or hydro-meteorological hazards including droughts, floods, landslides, and windstorms[47]. As a result, it has been observed that harnessing AI and other modern technologies in Africa and the Global South is key towards strengthening disaster risk management through risk identification, risk reduction, preparation, financial protection, resource allocation, and resilient recovery[48].

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[42] Disaster Management' Available at https://www.unoosa.org/oosa/de/ourwork/topics/disaster-management.html (Accessed on 02/05/2026)

[43] Organisation for Economic Co-operation and Development., 'AI in Law Enforcement and Disaster Risk Management' Op Cit

[44] World Meteorological Organization., 'Artificial Intelligence for Disaster Risk Reduction: Opportunities, challenges, and prospects' Available at https://wmo.int/media/magazine-article/artificial-intelligence-disaster-risk-reduction-opportunities-challenges-and-prospects (Accessed on 02/05/2026)

[45] Ibid

[46] World Meteorological Organization., 'Artificial Intelligence for Disaster Risk Reduction: Opportunities, challenges, and prospects' Op Cit

[47] African Union., 'Agenda 2063: The Africa we Want.' Available at https://au.int/sites/default/files/documents/33126-doc-framework_document_book.pdf (Accessed on 02/05/2026)

[48] Bello. O., & Fontes de Meira. L., 'The Use of Technology and Innovative Approaches in Disaster and Risk Management: A characterization of Caribbean Countries' Experiences' Available at https://repositorio.cepal.org/server/api/core/bitstreams/d1f94a03-ab00-4b25-9b3d98239b5327c1/content (Accessed on 02/05/2026)

Further, it is imperative to involve Africa and the Global South in AI governance in order to ensure that AI tools and systems are transparent, unbiased, ethical and accessible to the most vulnerable populations[49].

4.0 Conclusion

AI is a valuable tool that can strengthen disaster risk management thus protecting people and planet from the adverse impacts of disasters. It is therefore imperative to use AI to improve early warnings, damage assessment, resource allocation and long-term resilience for effective disaster risk management[50]. In particular, it is imperative to train AI models on quality, accurate, inclusive, sufficient and context-specific data bridge the digital divide between the Global North and the Global South in order to strengthen disaster risk management all over the world[51]. Using AI to improve early warnings, damage assessment, resource allocation and long-term resilience is therefore possible and achievable towards strengthen disaster risk management for people and planet.

[49] Artificial Intelligence (AI) for Disaster Risk Reduction., Op Cit
[50] Organisation for Economic Co-operation and Development., 'AI in Law Enforcement and Disaster Risk Management' Op Cit
[51] Ibid

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