

Climate Justice: Developing Early Warning Systems to Enhance Environmental Security and Resilience

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Table of Contents

Abstract..... 3

1.0 Introduction 3

2.0 Early Warning Systems and Climate Justice: Opportunities and Challenges..... 5

3.0 Developing Early Warning Systems to Enhance Environmental Security and Resilience 7

4.0 Conclusion..... 8

References..... 9

Climate Justice: Developing Early Warning Systems to Enhance Environmental Security and Resilience

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Abstract

This paper critically discusses how early warning systems can be effectively developed and harnessed towards fostering climate justice for people and planet. The paper observes that early warning systems provide an effective solution towards enhancing environmental security and resilience in the pursuit of climate justice. It discusses the specific application of early warning systems in climate action. Despite their role in bolstering climate action, the paper observes that the development and adoption of early warning systems remains a challenge globally especially in the Global South. It argues that failure to effectively develop and utilise early warning systems undermines climate justice by leaving vulnerable people and communities at the risk of adverse climatic events. Consequently, the paper suggests how early warning systems can be appropriately developed and utilised to enhance environmental security and resilience for climate justice.

1.0 Introduction

With climate change devastating people and planet, effective climate action has become an imperative at the global, regional, national and local levels in the pursuit of Sustainable Development. It has been observed that adverse climatic and weather events including heatwaves, wildfires, floods, sea-level rise, tropical storms, droughts and hurricanes are increasing in scale, frequency and intensity globally with severe impacts on people and planet¹. These impacts are causing dangerous and widespread disruption, depletion and degradation of nature while also affecting the lives, health, livelihoods and well-being of billions of people all over the world². Due to its adverse effects, climate change has been described as a real and present danger to the lives of billions of people today and to everyone on the planet in the foreseeable future³. Consequently, climate change has been identified as one of the greatest challenges of our time whose adverse impacts undermine the ability of all countries to achieve Sustainable Development⁴.

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¹ World Health Organization., 'Climate Change' Available at <https://www.who.int/news-room/factsheets/detail/climate-change-and-health#:~:text=Key%20facts,diarrhoea%20and%20heat%20stress%20alone>. (Accessed on 16/06/2026)

² Intergovernmental Panel on Climate Change., 'Climate change: a threat to human wellbeing and health of the planet. Taking action now can secure our future' Available at https://www.ipcc.ch/report/ar6/wg2/downloads/press/IPCC_AR6_WGII_PressRelease-English.pdf (Accessed on 16/06/2026)

³ Grzybowski. A., & Hunnie. C., 'Mediating Peace with Climate Change' Available at <https://ecopeaceme.org/wp-content/uploads/2022/03/mediating-peace-with-climate-change.pdf> (Accessed on 16/06/2026)

⁴ United Nations General Assembly., 'Transforming Our World: the 2030 Agenda for Sustainable Development.' 21 October 2015, A/RES/70/1., Available at <https://sustainabledevelopment.un.org/content/documents/21252030%20Agenda%20for%20Sustainable%20Development%20web.pdf> (Accessed on 16/06/2026)

Climate Justice: Developing Early Warning Systems to Enhance Environmental Security and Resilience

Effective climate action involves fostering climate justice. For example, it has been observed that the poor, marginalized and disadvantaged populations including indigenous peoples, local communities, women and girls and the youth are more vulnerable to the impacts of climate change⁵. Further, due to geographic and economic vulnerability, people and communities in the Global South are extremely vulnerable to climate change and its impacts⁶.

Climate change therefore causes injustices by disproportionately affecting vulnerable people and communities who have played a minor role in the accumulation of greenhouse gases responsible for the climate crisis. The concept of climate justice acknowledges that although climate change is a global crisis, its effects are not evenly felt around the world⁷. It has been observed that climate justice focuses on protecting human rights of the most vulnerable including the poor, women and girls, the youth, indigenous peoples and local communities who are adversely impacted by climate change⁸. This concept seeks to uphold equity, fairness, accountability and human rights in climate action by recognizing and addressing the disproportionate impacts of climate change on vulnerable individuals, communities and regions⁹. In particular, climate justice advocates for fair, just, inclusive and equitable climate actions and solutions that prioritize the needs of those who are most affected by climate change¹⁰. With the world witnessing a climate emergency, fostering climate justice is a key global agenda towards protecting vulnerable people and communities towards Sustainable Development.

This paper critically discusses how early warning systems can be effectively developed and harnessed towards fostering climate justice for people and planet. The paper observes that early warning systems provide an effective solution towards enhancing environmental security and resilience in the pursuit of climate justice. It discusses the specific application of early warning systems in climate action. Despite their role in bolstering climate action, the paper observes that the development and adoption of early warning systems remains a challenge globally especially in the Global South. It argues that failure to effectively develop and utilise early warning systems undermines climate justice by leaving vulnerable people and communities at the risk of adverse climatic events. Consequently, the paper suggests how early warning

⁵ Climate Justice Global Alliance., Available at <https://sdgs.un.org/partnerships/climate-justice-global-alliance> (Accessed on 16/06/2026)

⁶ Giles. M., 'The Principles of Climate Justice at CoP27.' Available at <https://earth.org/principles-ofclimatejustice/#:~:text=That%20response%20should%20be%20based,the%20consequences%20of%20climate%20change> (Accessed on 16/06/2026)

⁷ What is Climate Justice?., Available at https://globalwitness.org/en/campaigns/land-and-environmental-defenders/what-climate-justice/?gad_source=1&gad_campaignid=13050085427&gbraid=0AAAAADm6LOBCAWyVGIrV8P9t7a-3ITtgC&gclid=Cj0KCQIAo4TKBhDRARIsAGW29beo0CN5gLtHcdqr42LaywMKxO5VVbWiMDiQOaj-Bj3eLN4oXC55Ah0aAkNIeALw_wcB (Accessed on 16/06/2026)

⁸ Aliozi. Z., 'Climate Justice and Human Rights, in a World in Climate Emergency' Available at <https://repository.gchumanrights.org/server/api/core/bitstreams/2eba3de1-1427-481b-a2d6-07818e00a53b/content> (Accessed on 16/06/2026)

⁹ World Economic Forum., 'What is Climate Justice?' Available at https://www.weforum.org/videos/climate-justice/?gad_source=1&gad_campaignid=22228224717&gbraid=0AAAAAoVy5F63G-51xPZCfWH7BGSBXa909&gclid=Cj0KCQjwy_fOBhC6ARIsAHKFB7-f_LGoyvNwbnGjFgLRrT_dmP19I-82u3vFj4ys0nVW2O-I_rLH30AaAiFPEALw_wcB (Accessed on 16/06/2026)

¹⁰ Aliozi. Z., 'Climate Justice and Human Rights, in a World in Climate Emergency' Available at <https://repository.gchumanrights.org/server/api/core/bitstreams/2eba3de1-1427-481b-a2d6-07818e00a53b/content> (Accessed on 16/06/2026)

systems can be appropriately developed and utilised to enhance environmental security and resilience for climate justice.

2.0 Early Warning Systems and Climate Justice: Opportunities and Challenges

The United Nations Office for Disaster Risk Reduction (UNDRR) defines early warning systems as integrated systems of hazard monitoring, forecasting and prediction, disaster risk assessment, communication and preparedness activities systems and processes that enable individuals, communities, nations, businesses and others to take timely action to reduce disaster risks in advance of hazardous events¹¹. Early warning systems have also been described as technologies and processes aimed at reducing the impact of natural hazards including climate change by providing timely and relevant information in a systematic way¹². In addition, early warning systems have been defined as integrated systems designed to provide timely, accurate and actionable warnings of impending hazards such as cyclones, floods, droughts, heatwaves or wildfires¹³.

Early warning systems are crucial in bolstering the global response to climate change in the pursuit of climate justice. Early warning systems in general are the heart of Disaster Risk Reduction (DRR). The concept of DRR involves reducing the risk of disasters through systematic efforts to analyze and manage the causal factors of disasters including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land, environment and natural resources and improved preparedness for adverse events¹⁴. It has been observed that DRR aims at preventing new and reducing existing disaster risk and managing residual risk, all of which contribute to strengthening the resilience of people and planet against disasters for Sustainable Development¹⁵. Effective DRR approaches are vital in protecting people and planet from the negative impacts of disasters¹⁶. This can be achieved through early warning systems which provide timely and informed alerts on disasters thus enabling individuals, households, communities and nations to effectively anticipate, respond and recover from disasters therefore reducing the impact of disasters on human life, the environment and economic development¹⁷. Early warning systems can provide timely and actionable warnings of impending disasters such as cyclones, floods, droughts, heatwaves or wildfires thus bolstering DRR¹⁸.

¹¹ United Nations Office for Disaster Risk Reduction., 'Definition: Early warning system' Available at <https://www.undrr.org/terminology/early-warning-system> (Accessed on 17/06/2026)

¹² United Nations Development Programme., 'Five Approaches to Build Functional Early Warning Systems' Available at https://www.adaptation-undp.org/sites/default/files/resources/undp_brochure_early_warning_systems.pdf (Accessed on 17/06/2026)

¹³ United Nations Development Programme., 'What are early warning systems and why do they matter for climate action?' Available at <https://climatepromise.undp.org/news-and-stories/what-are-early-warning-systems-and-why-do-they-matter-climate-action> (Accessed on 17/06/2026)

¹⁴ Republic of Kenya., 'National Disaster Risk Management Policy' Available at <https://repository.kippra.or.ke/xmlui/bitstream/handle/123456789/559/NATIONAL%20Disaster%20Risk%20Management%20POLICY%20APPROVED.pdf?sequence=1&isAllowed=y> (Accessed on 17/06/2026)

¹⁵ United Nations Office for Disaster Risk Reduction., 'Definition: Disaster Risk Reduction' Available at <https://www.undrr.org/terminology/disaster-risk-reduction> (Accessed on 17/06/2026)

¹⁶ Disaster Risk Reduction., Available at <https://practicalaction.org/learning/climate-change/disaster-risk-reduction/> (Accessed on 17/06/2026)

¹⁷ International Labour Organization., 'The importance of early warning systems in disaster risk reduction' Available at <https://www.ilo.org/resource/article/importance-early-warning-systems-disaster-risk-reduction> (Accessed on 17/06/2026)

¹⁸ United Nations Development Programme., 'What are early warning systems and why do they matter for climate action?' Op Cit

Climate Justice: Developing Early Warning Systems to Enhance Environmental Security and Resilience

Developing early warning systems is therefore key towards strengthening DRR for Sustainable Development. In particular, it has been observed that early warning systems can foster climate justice by building resilience and safeguarding lives and livelihoods in the midst of mounting climatic hazards and disasters¹⁹. Early warning systems have a great potential to avert disaster risk and minimize loss and damage associated with climate-related hazards through supporting well-informed science-based decision-making²⁰. It has been observed that early warning systems are being utilized in many parts of the world to monitor, forecast, and warn people and communities about adverse consequences of climate change such as tropical cyclones, floods, storms, tsunamis, avalanches, tornadoes, severe thunderstorms, extreme heat and cold, forest fires, and drought among others²¹. Through this, it is possible to reduce loss of life and injury, minimize economic losses, protect critical infrastructure and safeguard the environment during climate-related hazards towards climate justice²².

With climate change devastating people and planet, early warning systems provide an effective solution that can enhance environmental security and resilience for climate justice and Sustainable Development. It has been observed that early warning systems can enable individuals, communities and nations at risk of adverse climatic events to take appropriate measures to reduce their risk, prepare and recover from potential impacts²³. The United Nations Environment Programme (UNEP) observes that well-functioning early warning systems can ensure that accurate, timely and actionable climate information reaches everyone that needs it thus informing sound decision-making processes that can drive climate justice²⁴. Through access to climate information, early warning systems enable individuals, communities and nations to build preparedness and strengthen resilience in the wake of a global climate crisis²⁵. Early warning systems can therefore drive climate justice since they play a key role in protecting lives, livelihoods and property towards Sustainable Development by enhancing timely evidence-based decision-making in the face of a worsening climate crisis²⁶. With extreme climatic events becoming more frequent and intense, early warning systems have the potential to turn risk into resilience towards climate justice²⁷.

Despite their key role in strengthening climate action and fostering climate justice, it has been observed that investments in early warning systems remain low²⁸. In particular, it has been observed that while most countries have meteorological departments, many developing countries lack adequate financial resources, infrastructure, human and technical capacity to maintain modern observation networks, analyse the data

¹⁹ Ibid

²⁰ United Nations Environment Programme., 'Climate Information and Early Warning Systems' Available at <https://www.unep.org/topics/climate-action/climate-transparency/climate-information-and-early-warning-systems> (Accessed on 17/06/2026)

²¹ Climate Adapt., 'Establishment of Early Warning Systems' Available at <https://climate-adapt.eea.europa.eu/en/metadata/adaptation-options/establishment-of-early-warning-systems> (Accessed on 17/06/2026)

²² United Nations Development Programme., 'What are early warning systems and why do they matter for climate action?' Op Cit

²³ Ibid

²⁴ United Nations Environment Programme., 'Climate Information and Early Warning Systems' Op Cit

²⁵ Ibid

²⁶ United Nations Development Programme., 'Climate Information and Early Warning Systems' Available at <https://www.adaptation-undp.org/climate-information-and-early-warning-systems> (Accessed on 17/06/2026)

²⁷ Ibid

²⁸ Ibid

Climate Justice: Developing Early Warning Systems to Enhance Environmental Security and Resilience

they produce, and apply it effectively in early warning systems and climate action and policy²⁹. For example, it has been observed that despite the progress made towards the development of observational networks in Africa, the continent's observational infrastructure has not yet met the optimum standards for effective forecasts and early warning systems³⁰.

Failure to develop effective early warning systems undermines climate justice since this leaves individuals, communities and nations at risk of adverse climatic events such as cyclones, floods, droughts, heatwaves or wildfires³¹. Without adequate anticipation and preparation, these events can lead to loss of lives, livelihoods, property and environmental damage thus undermining Sustainable Development³². Consequently, it is imperative to develop early warning systems in order to enhance environmental security and resilience towards climate justice.

3.0 Developing Early Warning Systems to Enhance Environmental Security and Resilience

It has been observed that as climate change intensifies, access to reliable and timely climate data and information is no longer a luxury but a necessity in order to protect people and planet from adverse climatic events³³. Early warning systems can save lives, protect livelihoods and inform sound decision-making processes that bolster climate action³⁴. In particular, it has been observed that early warning systems can foster climate justice by enabling vulnerable communities, especially in developing countries to adequately prepare for and respond to climate shocks³⁵. Early warning systems have been identified as among the most efficient and cost-effective climate adaptation measures available due to their potential to prevent losses from adverse events such as floods, storms, heatwaves and wildfires³⁶. In particular, it has been observed that in weather-sensitive sectors such as agriculture, fisheries, energy and transportation, early warning systems can help protect livelihoods and economic gains towards Sustainable Development³⁷.

It is therefore imperative to develop early warning systems in order to enhance environmental security and resilience towards climate justice. In particular, countries have been urged to build effective early warning systems that ensure that precursors to extreme climatic events are monitored on a continuous basis, data is analysed to generate a forecast, and that if there is a forecast of a large event, a warning is issued to those likely to be affected³⁸. Effective early warning systems involve monitoring and forecasting

²⁹ Ibid

³⁰ African Union., 'African Union Climate Change and Resilient Development Strategy and Action Plan' Available at https://au.int/sites/default/files/documents/42276-doc-CC_Strategy_and_Action_Plan_2022-2032_23_06_22_ENGLISH-compressed.pdf (Accessed on 17/06/2026)

³¹ United Nations Development Programme., 'What are early warning systems and why do they matter for climate action?' Op Cit

³² Ibid

³³ United Nations Development Programme., 'How climate information and early warning systems protect lives and economies' Available at <https://climatepromise.undp.org/ciews> (Accessed on 17/06/2026)

³⁴ Ibid

³⁵ United Nations Development Programme., 'What are early warning systems and why do they matter for climate action?' Op Cit

³⁶ United Nations Development Programme., 'How climate information and early warning systems protect lives and economies' Op Cit

³⁷ Ibid

³⁸ Republic of Kenya., 'National Framework for Climate Services' Available at https://meteo.go.ke/sites/default/files/downloads/NFCS_Kenya_11_Oct_2023_0.pdf (Accessed on 17/06/2026)

Climate Justice: Developing Early Warning Systems to Enhance Environmental Security and Resilience

of the occurrence and intensity of hazards and effectively communicating timely and accurate warnings to those at risk through appropriate channels such as television, radio, internet, satellite and mobile services³⁹.

Further, it has been observed that effective, early warning systems need to actively involve the people and communities at risk from a range of hazards, facilitate public education and awareness of risks, disseminate messages and warnings efficiently and ensure that there is a constant state of preparedness and that early action is enabled⁴⁰. It has been correctly observed that participatory or people-centered early warning systems have great potential to improve decisions taken by both emergency institutions and communities exposed or affected by climate hazards⁴¹.

In addition, it has been observed that indigenous knowledge and community-based observations can complement scientific forecasting, enhancing accuracy and relevance for at-risk populations⁴². Indigenous peoples and local communities all over the world have developed an array of early warning indicators and well-developed structures that enable them to effectively predict and deal quickly and efficiently with disasters⁴³. Indigenous early warning systems include the ability to predict extreme weather events such as heavy rainfall, droughts, and famine which enables indigenous peoples and local communities to prepare adequately for the impacts of such events⁴⁴. Indigenous knowledge can therefore complement scientific forecasting towards the development of inclusive, accessible and culturally-appropriate early warning systems⁴⁵.

4.0 Conclusion

Early warning systems provide a vital solution towards climate justice. If well-developed and correctly implemented, early warning systems can help to reduce losses of lives and property, protect livelihoods and to minimise environmental damage associated with the adverse impacts of climate change⁴⁶. It is therefore imperative to develop effectively early warning systems in order to enhance environmental security and resilience towards climate justice and Sustainable Development.

³⁹ United Nations Development Programme., 'What are early warning systems and why do they matter for climate action?' Op Cit

⁴⁰ Climate Adapt., 'Establishment of Early Warning Systems' Available at <https://climate-adapt.eea.europa.eu/en/metadata/adaptation-options/establishment-of-early-warning-systems> (Accessed on 17/06/2026)

⁴¹ Marchezini. V et al., 'A Review of Studies on Participatory Early Warning Systems (P-EWS): Pathways to Support Citizen Science Initiatives' Available at <https://www.frontiersin.org/articles/10.3389/feart.2018.00184/full> (Accessed on 17/06/2026)

⁴² United Nations Development Programme., 'What are early warning systems and why do they matter for climate action?' Op Cit

⁴³ United Nations Office for Disaster Risk Reduction., 'Indigenous Disaster Early Warning, Preparedness, and Response' Available at https://www.unisdr.org/preventionweb/files/18123_indigenousdisasterearlywarningprepa.pdf (Accessed on 17/06/2026)

⁴⁴ Ibid

⁴⁵ United Nations Development Programme., 'What are early warning systems and why do they matter for climate action?' Op Cit

⁴⁶ Ibid

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Climate Justice: Developing Early Warning Systems to Enhance Environmental Security and Resilience

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Climate Justice: Developing Early Warning Systems to Enhance Environmental Security and Resilience

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