Environmental Laws and Artificial Intelligence as Promising Tools for Tackling Climate Migration

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Abstract:

Environmental migration is becoming a reality due to climate change caused by human activities. Environmental migrants, also known as climate migrants, are individuals forced to leave their usual homes, either temporarily or permanently, and relocate within or outside their home country as a result of sudden or progressive climate change. These environmental alterations negatively impact their lives or living conditions. The term “environmental migrant” was used by the United Nations Environment Program (UNEP) in Nairobi in 1985, and member states of the International Organization for Migration reached an agreement on a working definition in 2007. This definition reflects a growing understanding of how the environment and climate affect migration patterns. Given the proven efficacy of artificial intelligence (AI) across various disciplines, the study aims to show how AI can be applied to improve and implement sustainable development plans.

The United Nations has set 2030 as the deadline for achieving all of these goals. This research presents the available environmental legislation on both international and regional levels and provides a comparative analysis of these regulations. Moreover, the role of AI in tackling the obstacles associated with environmental mobility is investigated as well.

Keywords: Artificial Intelligence (AI), Environmental Migration, Climate Change, Laws, Human Rights.

1. Introduction

Climate change, driven by unsustainable human activity, has made environmental migration a stark reality(1). Remarkably, "Ioane Teitiota", a man from the island nation of Kiribati, and his family were among the first in the world to seek environmental asylum. Their plight stems from the effects of climate change, as rising sea levels have deprived them of any chance to establish a future in their homeland(2). Consequently, several countries and international organizations have given this issue increased attention, considering it alongside matters of human rights and democracy.

This subject is mainly related to human rights and significant attempts are being pursued to tackle climate change(3). These initiatives range from international agreements to the development of relevant legislation. The use of artificial intelligence (AI) and its applications in the field of environmental migration is currently being investigated. These technologies can be very useful in monitoring environmental changes and providing precise analyses that aid in making more effective decisions to solve environmental concerns, especially given the rapid growth of AI and its integration into numerous disciplines(4).

AI can be instrumental in designing strategies to combat climate change and mitigate environmental migration.

(1) F. Martin Susan, 'New Models of International Agreement for Refugee Protection' (2016) JMHS Volume 4 Number 3, 60,75.

(2) B. Stojanovic, 'The view of the Human Rights Committee in the case of Ioane Teitiota v. New Zealand, and its relevance for international law' (2020) Collection Papers Fac. L. Nis, **87, 73.**

(3) M. Ermolina, A. Matveevskaya, & M. Baranuk, 'Climate change and the UN 2030 agenda for sustainable development' (2021) In Proceedings of Topical Issues in International Political Geography Springer International Publishing, 226,237.

(4) A. Al-Othman, M. Tawalbeh, R. Martis, S. Dhou, M. Orhan, M. Qasim, A. Ghani Olabi 'Artificial intelligence and numerical models in hybrid renewable energy systems with fuel cells: advances and prospects' (2022) Energy Convers Manag 115154, 253.

Further, we are currently witnessing numerous and diverse advancements across all aspects of life. These changes are happening quickly and on a daily basis. Technological innovations flourished as a result of the second and fourth industrial revolutions, which fostered an innovation culture. This is a result of the software's facilitation, which enables these nations to accomplish their objectives efficiently and effectively**.** Integrating artificial intelligence into the legal sector is no longer a distant prospect but a present reality. Artificial intelligence has the potential to improve legal services' efficiency, accuracy, and accessibility of legal services by automating repetitive tasks and providing predictive insights. As technology develops further, it could lead to the emergence of new areas of legal practice.

Artificial intelligence origins can be traced back to 1950, when Alan Turing, a British computer scientist, created a test known as the "Imitation Game," which was later renamed the Turing test. The test aimed to evaluate a computer's intelligence by comparing it to that of humans, leading to his key conclusion: it is possible for machines to think like humans(1). Following that, artificial intelligence-related inventions started to appear and proliferate. Examples of these developments include computer chess games, but in 1987 they experienced a sharp decline due to a downturn in the business industry and this period was known as the "AI Winter," which saw significant reductions in funding for exploratory research by governments in the US and the UK. The twenty-first century, however, has witnessed a resurgence of AI, with significant advancements and widespread adoption across various sectors, including the development of Google's Alpha-Go program and advanced medical diagnostic techniques. Developed countries such as France, China, Japan, the United Kingdom, and the United States are committed to AI research and development to address their specific needs.

However, legal disputes have emerged along with the development of AI. The increasing interaction between humans and robots, coupled with the use of sophisticated AI capable of learning and reasoning from programmed data, creates novel challenges. Legal regulation for this kind of technology is necessary due to the potential for errors and harm. Given the crucial role of law in society, particularly in serving the public interest and protecting minorities, legal oversight is essential in the digital age. Public law remains a vital tool for

(1) Turing M. Alan, 'Computing Machinery and Intelligence' (October 1950) Mind, Vol. Lix, issue 236, 433,460.

supervision and control. Legislators must address existing legal gaps, as current technologies struggle to understand social conventions, especially when fundamental constitutional principles are at stake.

Software companies have acknowledged the potential for severe consequences and substantial losses if AI systems fail to adhere to legal and ethical guidelines(1). Therefore, this study aims to examine the role of environmental and international laws concerning climate migration and provides a comparative regional analysis. Furthermore, it investigates how the application of artificial intelligence tools can mitigate climate migration while upholding ethical standards.

2. Climate Change Impacts

One of the most pressing problems facing humanity today is climate change, characterized by long-term shifts in global weather patterns(2). Its far-reaching effects transcend national borders, impacting economies, communities, and ecosystems worldwide.

Millions of people globally are being displaced by the effects of climate change, a situation projected to worsen as sea levels continue to rise and deserts expand. [3]

According to a World Bank analysis, by 2050, these effects could force 143 million persons to migrate within three of the vulnerable regions: sub-Saharan Africa, South Asia, and Latin America(3). Additionally, climate experts predict that by 2100, asylum applications to the European Union could reach approximately 450,000 annually if global temperatures continuetoclimb.(4)

Over the last ten years, the International Organization for Migration has focused on raising awareness of environmental and climatic factors and gathering data to demonstrate how climate change directly and indirectly affects human mobility. However, there are no spe-

(1) E. Medina, Rethinking algorithmic regulation (2015) Kybernetes, 44(6/7), 1005,1019.

(2) A. El-Sayed, & M. Kamel, 'Climatic changes and their role in emergence and re-emergence of diseases' (2020) *Environmental Science and Pollution Research*, *27*, 22336-22352.

(3) Ezgi Complat & Aly Rahim, AI and climate: Tackling challenges and embracing change with a people-centered approach, March 05,2024, WORLD BANK LOGS https://blogs.worldbank.org/ar/voices/aldhka-alastnay-walmnakh-altsdy-llthdyat-waltghyyr-bnhj-yray-aht accessed 12/6/2024.

(4) A. Missirian, & W. Schlenker, 'Asylum applications and migration flows' (2017) *American Economic Review*, *107*(5), 436,440.

cific and clear legal frameworks in place for the status and regulation of climate migrants. Although not a direct cause of war, climate change acts as a threat multiplier, exacerbating resource scarcity and existing vulnerabilities. The United Nations Security Council has acknowledged that climate change could impact security. Competition for natural resources, among other factors, fuels conflicts between farmers and herders.

Historically, seasonal migration fostered peaceful interactions between these groups due to the complementary nature of their livelihoods and established agreements.

However, in recent decades, several factors have strained these agreements. These include, but are not limited to, competition for scarce natural resources, the adverse effects of climate change, and evolving socioeconomic trends. Conflicts between herding and farming communities have resulted in rapidly escalating tensions and violence, claiming thousands of lives [(1)]. Therefore, climate change remains a critical and complex global issue requiring a concerted and sustained commitment from governments, businesses, and individuals [(2)]. It is essential to address the underlying causes of climate change and implement practical mitigation measures while dealing with its effects. A commitment to sustainable practices and continuous innovation is necessary to create a resilient and equitable future for generations to come. In this context, combating climate change is not only an environmental imperative but also a shared responsibility for the well-being of our planet and all its inhabitants.

3. Environmental Migration Definition and Policies

The concept of environmental migration has proven contentious, primarily due to the difficulty in quantifying the extent to which environmental factors compel individuals to relocate. Environment and migration experts have offered varying definitions of “environmental refugee” since the term’s emergence in the 1980s[(3)].

The Intergovernmental Panel on Climate Change (IPCC) released a warning in 1990 that

(1) United Nations, Conflict and natural resources, Link: http://peacekeeping.un.org/en/conflict-and-natural-resources, accessed 10/7/2024.

(2) D. Scott, ‘Sustainable tourism and the grand challenge of climate change’ (2021) *Sustainability*, *13*(4), 1966.

(3) I. Omelaniuk, ‘Introduction: Making the connections between migration and development’ (2012) Global Perspectives on Migration and Development: GFMD Puerto Vallarta and Beyond, 1-25.

significant migration levels would arise as a result ~~to~~ of altered climate conditions(1). These migrants are individuals compelled to leave their homes, either internally or across international borders, due to drastic changes in their living conditions and environment.

Environmental refugees are "people who can no longer gain a secure livelihood in their homelands because of drought, soil erosion, desertification, and other environmental problems, together with associated problems of population pressures and profound poverty," according to Norman Myers' 2005 definition of those displaced by climate change.

But the principal legal question is: Are these individuals classified as refugees? A person who is outside his/her country of nationality and unable or not willing to take advantage of that country's protection because of a substantiated fear of being persecuted for reasons of race, religion, nationality, membership in a particular social group, or political opinion is considered a refugee, according to the UN convention covering the status of refugees (Art.1, Convention relating to the status of refugees, hereby Refugee Convention). Prosecution is the legitimate basis for obtaining asylum and refugee status, according to the refugee convention(2).

Forced relocation provoked by climate change is no longer a factor in determining whether someone qualifies for refugee status. It is more common to refer to someone as a "climate refugee" than it is in law. Additionally, this phrase is being scrutinized more closely for a variety of reasons. Initially, it is expected that climate change will induce some displacement; however, the degree of this displacement will rely on both the climate and the availability and efficacy of adaptation strategies that assist people in coping with the stressors of their environment. The uncertainty is the existence of such effective adaptation methods, as political economics at the local, regional, national, and international levels play a key role in this regard. While it is a common practice to refer to any group of forced migrants as "refugees," UNHCR (United Nations High Commissioner for Refugees**)** and IOM (International Organization for Migration) advise against using the terms "environmental" or "climate refugees," as they have no legal basis in international law and may jeopardize the system of international protection for refugees. Human rights law may be a suitable legal framework

(1) E. Fornalé, J. Guélat, & E. Piguet, 'Framing labour mobility options in small island states affected by environmental changes' (2016) Springer International Publishing, 167,187.

(2) M. Andeva, & V. Salevska-Trajkova, 'Climate refugees or climate migrants: How environment challenges the international migration law and policies (2020).

for climate-related migration, as it has been in practice and has been extensively explored(1). Migration and international organization experts assigned to monitoring various forms of human mobility and humanitarian relief have expressed particular concern about the possibility of anti-migrant judgment and misinterpretation of terms such as "refugee," which have precise definitions in international law, by individuals who highlight the possibility of large-scale emergency migrations. Even though there is a growing body of research on the connection between migration and climate change(2), it is still intricate to develop an appropriate policy framework in the absence of precise estimates of the number, location, and duration of potential migration. However, even in cases when it is recognized that there will probably be some kind of migration triggered by environmental change, there are not enough institutional or governmental solutions that are thought to be suitable for these kinds of migrations, making it difficult to deal with these movements(3).

The Global Forum on Migration and Development's agenda item on climate change and migration is relatively recent. Policymakers should "give serious consideration to the impact of climate change on migration and to joint efforts to face this challenge," according to the Government GFMD (Global Forum on Migration and Development) discussions in Athens. It also mentioned the necessity of "mainstreaming and integrating migration into development planning processes, including National Adaptation Plans of Action concerning climate change (NAPAs)". While some migration may be for a short period, others can be perpetual. Numerous factors are taken into consideration upon deciding whether a return is feasible, one of which is the likelihood of the persistence of the environmental causes' continuity either directly or indirectly. Depending on whether the migration is internal or international, policies of the hosting communities and nations will also have an impact on the return or residence in the new area of migrants.

Land use and property rights, employment**,** social welfare, housing, and other contexts that govern whether people can find decent living conditions and pursue adequate liveli-

(1) j. McAdam, & B. Saul, 'An insecure climate for human security? Climate-induced displacement and international law' (2009).

(2) V. Kolmannskog, 'The point of no return: exploring law on cross-border displacement in the context of climate change' (2009) 27-42 *Refugee Watch*, *34*. ET E. Piguet, A. Pécoud, & P. De Guchteneire, 'Migration and climate change: An overview' (2011) Refugee Survey Quarterly, 30(3), 1-23.

(3) S. Martin, and K. Warner, 'Climate Change, Migration, and Development in Irena Omelaniuk' (Springer 2012), (Ed.), Global perspectives in migration and development.

hoods are among the policies that affect return and settlement besides immigration laws. Developing nations with large populations engaged in agriculture, herding, or fishing are extremely vulnerable to the impacts of natural disasters and alterations in the environment.

Many of the world's poorest and most crisis-prone countries will be disproportionately affected by climate change due to pre-existing human vulnerabilities, weak capacities for risk reduction measures, and greater exposure to climate-related hazards such as droughts and floods(1). However, even severely damaging natural disasters do not always lead to humanitarian crises resulting in large-scale displacement. The ability of people to rebuild their homes and livelihoods following natural disasters largely depends on the effectiveness of national and international institutions, policies, and humanitarian responses.

4. International Climate Change Legislations

In order to solve the growing environmental issues that the global society is facing, legislative action in response to climate change has become essential(2). Globally, governments are enacting laws to address climate change, seeing the necessity of all-encompassing plans to reduce greenhouse gas emissions, switch to renewable energy, impose carbon pricing schemes, and improve adaptation plans.

The challenging part of the problem is reflected in the wide range and complexity of the legislative environment addressing climate change(3). Legislation complying with international agreements and scientific advice has been enacted by nations across the globe, acknowledging the urgent demand for climate action. The established legal frameworks reflect the distinct socio-economic and environmental conditions of each country, but they differ greatly in terms of their scope, strictness, and methodology.

A lot of climate laws are founded upon emissions reduction targets, which set precise objectives for reducing greenhouse gas emissions within a predetermined period of time. (4)

(1) S. Martin, and K. Warner, 'Climate Change, Migration, and Development in Irena Omelaniuk' (Springer 2012), (Ed.), Global perspectives in migration and development.

(2) M. P. Nevitt, 'On environmental law, climate change, & national security law' (2020) *Harv. Envtl. L. Rev.*, *44*, 321.

(3) I. A. Reshi, 'Unpacking the complexities of economic systems: exploring trends, challenges and solutions' (2023) Journal of Accounting Research, Utility Finance and Digital Assets, 1(4), 393,398.

(4) H. Kros, T. Cals, E. Gies, P. Groenendijk, J. P. Lesschen, J. C. Voogd, T. Hermans, & G. Velthof, 'Region oriented and integrated approach to reduce emissions of nutrients and greenhouse gases from agriculture in the Netherlands. Science of the Total Environment' (2024), 168501, 909.

Governments guarantee to lower their carbon footprint, often expressed as a percentage of baseline levels. The United Nations Framework Convention on Climate Change (UNFCCC) global agreement known as the Paris Agreement is an example of a collaborative effort in which nations establish Nationally Determined Contributions (NDCs) pledging their promises to decrease emissions.

A key factor in abandoning fossil fuels is legislation that encourages the use of renewable energy sources(1). Many countries have established laws to encourage and demand the inclusion of renewable energy in their energy mix. Feed-in tariffs (FIT), renewable portfolio standards (RPS), and tax breaks are some examples that are intended to encourage investments in solar, wind, hydro, and geothermal energy. The goals of these legislative frameworks are to encourage renewable energy, lower emissions, promote a sustainable energy future, and lessen dependency on carbon-intensive energy sources. By offering financial enticement for businesses to lessen their carbon footprint, carbon pricing schemes seek to internalize the external cost of carbon emissions(2).

Carbon taxes and cap and-trade programs are two popular strategies. According to(3), carbon taxes incentivize firms to reduce their carbon emissions by charging a fee per unit of carbon released. Cap-and-trade programs set a limit on total emissions and distribute or exchange permits, stimulating emission reductions in highly economical areas.

Legislative responses should encompass adaptation methods since certain climatic impacts are unavoidable(4). These approaches cover a broad range of actions intended to reduce vulnerabilities and increase resilience under shifting climatic circumstances. The generation of early warning systems to lessen the effects of extreme weather occurrences, sustainable land-use planning, infrastructural upgrades, and water resource management may be the main subject matter of legislation. A multinational program called the Sendai Framework for Disaster Risk Reduction highlights the significance of adaptation methods in creating resilient communities.

(1) G. Mutezo, & J. Mulopo, 'A review of Africa's transition from fossil fuels to renewable energy using circular economy principles' (2021) *Renewable and Sustainable Energy Reviews*, *137*, 110609.

(2) L. Klevtun, & M. Nilsson, 'Internalizing externalities with internal carbon pricing A case study on how to drive change and prepare for a low-carbon economy' (2021).

(3) S. Dissanayake, R. Mahadevan, & J. Asafu-Adjaye, 'Evaluating the efficiency of carbon emissions policies in a large emitting developing country' (2020). *Energy Policy*, *136*, 111080.

(4) S.J. Birchall, & N. Bonnett, 'Climate change adaptation policy and practice: The role of agents, institutions and systems' (2021) *Cities*, *108*, 103001.

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To summarize, a collaborative commitment to reducing the effects of global warming and promoting a sustainable future is reflected in the worldwide legislative landscape addressing climate change(1). The main foundations of this legislative approach include carbon pricing mechanisms, renewable energy adoption, emissions reduction targets, and adaptation methods. The efficacy of legislative frameworks will be determined by how well they integrate these elements, taking into account the interconnection of environmental, economic, and social variables, as countries continue to navigate the complexity of climate change. International cooperation, knowledge exchange, and continuous dedication are essential for the efficient execution of laws that can prompt significant advancements in the worldwide battle against climate change(2).

5. National Climate Change Legislations: Comparative Analysis

The global challenge of climate change necessitates a nuanced understanding of local variations in legislative strategies(3). Governments across continents are grappling with diverse socioeconomic, topographical, and climatic conditions, resulting in the development of distinctive policies suited to their specific opportunities and challenges. Further, this section explores these regional differences in climate policy, examining legislative strategies in Europe, North America, Asia, Africa, and South America.

With an emphasis on cooperation and multilateralism, Europe has been leading the way in combating climate change(4). The European Union (EU) has committed to becoming climate neutral by 2050, among other goals. One of the most notable initiatives is the EU Emissions Trading System (EU ETS), which uses a cap-and-trade system to restrict greenhouse gas emissions. Furthermore, the European Green Deal presents an in-depth plan for an inclusive and sustainable green transition that includes laws associated with biodiversity, energy

(1) H. Lee, K. Calvin, D. Dasgupta, G. Krinner, A. Mukherji, P. Thorne, C. Trisos, J. Romero, P. Aldunce, K. Barret, & G. Blanco, 'Climate Change 2023' (2023) Synthesis Report, Summary for Policymakers. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland IPCC, 2023.

(2) C. U. Akpuokwe, A. O. Adeniyi, S. S. Bakare, & N. E. Eneh, 'Legislative responses to climate change: a global review of policies and their effectiveness' (2024) *International Journal of Applied Research in Social Sciences 6*(3), 225,239.

(3) E. Carmen, I. Fazey, H. Ross, M. Bedinger, F. M. Smith, K. Prager, K. M. Clymont, & D. Morrison, Building community resilience in a context of climate change: The role of social capital (2022) *Ambio*, *51*(6), 1371,1387.

(4) R. Kinley, M. Z. Cutajar, Y. de Boer, & C. Figueres 'Beyond good intentions, to urgent action: Former UNFCCC leaders take stock of thirty years of international climate change negotiations' (2021) Climate Policy, 21(5), 593,603.

efficiency, and renewable energy.

Canada and the US have different climate policies. With its Pan-Canadian Framework on Clean Growth and Climate Change, which specifies policies including carbon pricing, phase-out of coal, and increased adoption of renewable energy, Canada has shown its dedication to the cause. Because of differences in federal policy, state-level initiatives in the US are apportioned around the country. While some states, like California, have enacted comprehensive climate legislation, others are still trailing behind. California has set strict emissions reduction objectives and mandates renewable energy sources and a cap-and-trade scheme.

Asia displays a variety of climate strategies on account of its heterogeneous economies and different stages of development(1). The greatest emitter in the world, China, has set elevated goals to peak emissions and become carbon neutral by 2060, and they are making significant investments in electric cars and renewable energy. India's strategy combines initiatives to improve energy efficiency, expand the use of renewable energy sources, and implement forest restoration projects. Japan is pushing sustainable finance to hasten the shift to a low-carbon economy through its Clean Energy Finance Initiative.

African countries confront distinct difficulties, such as resource scarcity, susceptibility to climate change, and objectives for development(2). The significance of climate resilience and sustainable development is acknowledged in the African Union's Agenda 2063. A number of nations have started enacting regulations related to sustainable land management and reforestation. The African Renewable Energy Initiative seeks to concurrently achieve energy access and climate goals by expanding the capacity of renewable energy sources throughout the continent. Countries in South America struggle with deforestation, agriculture emissions, and distinctive ecosystems(3). Brazil has committed to reforestation and renewable energy programs, despite criticism of its policies arising from rising deforestation in the Amazon. Conversely, Chile has demonstrated a commitment to a sustainable energy system by enacting carbon pricing systems and setting high targets for renewable energy.

(1) W. F. Lamb, & J. C. Minx, 'The political economy of national climate policy: Architectures of constraint and a typology of countries' (2020) *Energy Research & Social Science*, *64*, 101429.

(2) C. Nhemachena, L. Nhamo, G. Matchaya, C. R. Nhemachena, B. Muchara, S. T. Karuaihe, & S. Mpandeli, 'Climate change impacts on water and agriculture sectors in Southern Africa: Threats and opportunities for sustainable development' (2020) 2673 *Water*, *12*(10).

(3) H. Kamyab, M. SaberiKamarposhti, H. Hashim, & M. Yusuf, 'Carbon dynamics in agricultural greenhouse gas emissions and removals: a comprehensive review' (2023) Carbon Letters, 1-25.

The United States, China, and the European Union are key international players and thus are all working to address climate migration issues through different legislations and policies. In the time the European Union has adopted a preventive approach for reducing harmful emissions to achieve climate neutrality by 2050, the United States has focused on reducing domestic pollution by proclaiming environmental laws. Hence, the legal framework in the European Union is more focused on the reduction of international emissions and investing in renewable energy. The United States targets more local solutions to reduce internal pollution through enacting strict environmental regulations and laws. The program of environmental protection legislation in China was passed in 1989, and it played a crucial role in the early days of environmental control.

Nevertheless, there are still challenges in addressing environmental migration that need international cooperation and a comprehensive and thorough legal framework. Therefore, we will conduct a comparison between the international environmental legislative goals.

The United States relies on laws such as the "Clean Air Act" and the "Acid Rain Program" to decrease emissions and control pollution. The main focus in the U.S. is on reducing local environmental pollution via strict laws and regulations such as the "cap-and-trade system."

On the other hand, the European Union aims to achieve "climate neutrality" and is an international leader in environmental legislation through the "European Climate Law" and the "European Green Deal", in addition to the Environmental policies like the "Clean Air Directives" and "Biodiversity Protection Laws". These legislations tend to reduce emissions and preserve natural resources. The EU also targets the transition to renewable energy and enhancing energy efficiency to meet climate goals.

China launched the world's largest carbon trading market on July 16, 2021. At initiation, over 2,225 companies (most of which are state-owned enterprises (SOEs) in the power generation sector) were covered in the carbon market. These companies are responsible for approximately half of China's energy-related emissions and 10 to 14% of the world's total.

Under the carbon trading scheme, each company is allocated a specific amount of CO2 emissions allowances annually by the government.[1] If a company's emissions at the end of the year are below its allocated limit, it can sell the remaining allowances on the market as credit. Conversely, if the company exceeds its limit, it must purchase additional credits to offset the excess emissions. Failure to pay quotas on time is regarded as incompliance and will lead to penalties. As of May 2022, the Ministry of Ecology and Environment (MEE) has

penalized over 100 firms in the national carbon market for non-compliance.

Concerning India, the main environmental laws are underpinned by five key legislations: the Forest (Conservation) Act, 1980; the Air (Prevention and Control of Pollution) Act, 1981; the Environment (Protection) Act, 1986; the Wildlife (Protection) Act, 1972; and the Water (Prevention and Control of Pollution) Act, 1974.

As in other countries, these environmental legislations establish **parameters for businesses to follow, such as** standards for air emissions and wastewater discharge. In India, air and water pollution are major concerns. However, these regulations **haven**'t been updated since they were initially formulated in the mid-1970s and 1980s.

In Africa, the African Convention on the Conservation of Nature and Natural Resources, adopted in 1968, serves as the cornerstone of the African Union's environmental legal framework. The convention's primary objectives encourage individual and collective action from economic, nutritional, scientific, educational, cultural, and aesthetic perspective for the conservation, utilization, and development of soil, water, flora, and fauna. In this regard, states adopted the necessary measures to achieve the mentioned goals in accordance with scientific principles and with due regard to the best interests of the people (Article II); to take effective measures to conserve and improve the soil and to control erosion and land use (Article IV); and to establish policies to conserve, utilize, and develop water resources, prevent pollution, and control water use (Article V).

The EU has begun to acknowledge environmental migration as a significant issue, particularly in light of the climate impacts in the Middle East and Africa. The EU is adopting financial policies that support developing countries in adapting to climate change, thereby mitigating environmental migration. On the other hand, the U.S. legal framework does not officially identify environmental migration as a valid reason for asylum, that poses a challenge in addressing increasing environmental crises.

Overall, the effectiveness of all these environmental legislations is crucial for addressing the global challenges posed by climate change. As governments globally implement diverse legislative responses, it is essential to evaluate their impact, refine strategies, foster international collaboration, and inform future policymaking.

6. AI and the Environment

According to the United Nations Environment Program (UNEP), there has been a

connection between natural resources and intrastate conflicts in at least 40% of cases over the past 60 years. The exploitation of natural resources, including fertile land, water, gold, minerals, and oil, has been the driving force behind at least 18 violent wars since 1990 (United Nations, Conflict and Natural Resources). When required and suitable, member states should enact incitement promoting the development and approval of AI-powered solutions that are morally and ethically grounded in human rights, disaster risk reduction, ecosystem monitoring, restoration, and regeneration, and planet preservation. Local and indigenous communities should be involved throughout the AI system's life cycle. The AI system should also promote sustainable patterns of consumption and production as well as circular economy techniques. Some examples concerning using AI systems when needed are(1):

(a) To support the monitoring**,** protection, and management of natural resources.

(b) To support the control and mitigation, prediction, and prevention of climate-related problems.

(c) To support a more efficient and sustainable food ecosystem.

(d) To support the acceleration of sustainable energy adoption.

The first artificial intelligence law was, with one accord, approved by the UN on March 21, 2024, with the goals of advancing human rights, monitoring dangers, and personal data protection. The resolution declared, "Risks that can undermine the protection, promotion, and exercise of human rights and fundamental freedoms are posed by harmful or flawed design, development, deployment, and use of artificial intelligence systems.

Human rights remain a central concern, uniting people across the globe. Consequently, discussions on the most effective ways to protect and uphold these rights are frequent and evolving, particularly in light of the changing nature of human life. As a result, the international community, through the United Nations and its agencies, has been working to establish legal frameworks that ensure environmental protection and address the challenges of environmental migration, mirroring its efforts in safeguarding previously established rights and freedoms.

(1) UNESCO, Recommendation on the Ethics of Aetificial Intelligence, UNESCO Digital Library, year of publication 2022, https://unesdoc.unesco.org:/ark:/48223/pf0000381137 accessed 17/5/2024.

The Paris Climate Agreement and the United Nations Educational, Scientific, and Cultural Organization (UNESCO) recommendations on the ethical issues related to artificial intelligence emphasize the necessity of coordinating technological advancements with global environmental responsibilities when analyzing the intersection of international climate agreements and the crucial role of AI in addressing climate change.

Limiting global warming is the goal of the Paris Agreement. Article 10 of the accord recognizes the fundamental role of technology in preventing climate change, even though it does not specifically address AI. It highlights how essential it is to design and implement technology that lowers greenhouse gas emissions and increases adaptability. Artificial intelligence has emerged as the go-to consultant on the basis of its applications' ability to simplify difficult problems and the ensuing reliance on outside expertise.

The application of AI to environmental migration can take a part of human rights. Deep learning has made it possible to anticipate, evaluate, and react to crucial human rights scenarios more effectively. People can communicate with pro bono attorneys who are defending people's human rights by using AI-powered voice translation(1).

While planned movement can sometimes be an adaptation strategy, it is best to collaborate with affected governments to find solutions that combine in situ adaptation and migration. However, this needs to be taken into account within the context of human rights. Adaptation must occur with dignity; it cannot happen at all price.

Taking this into account, several governments are focusing on solutions for planned migration. People can move away from the effects of climate change relatively safely through managed international migration, as long as they are not treated as needing international "protection" (from an abusive or persecutory state) in the traditional sense of refugee or human rights law. Additionally, because the effects of slow-onset climate change are less likely to activate current or future temporary safety measures intended to avoid rapid disasters, managed migration paths are better adapted to deal with. Even though migration might improve a community's ability to adapt to climate change, this is probably going to be the case in situations where displacement decisions have a great deal of freedom. The greatest possible outcome can be achieved by guaranteeing that individuals who relocate are granted the same rights as members of the host community, which would typically

(1) Smith Brad, 'Using AI to help save lives' (Sep 24, 2018) Link: https://blogs.microsoft.com/on-the-issues/2018/09/24/using-ai-to-help-save-lives/ accessed 2/9/2024.

involve the rights of permanent residents under domestic law. Additionally, mutual understanding between these groups can be encouraged, covering relocation costs (thus urging the need to establish an international relocation fund), making property rights clear, and reinforcing emergency response systems.

Enhancing the pace and effectiveness of local interventions on environmental migration through artificial intelligence usage is necessary for building local mechanisms addressing environmental migration, which is becoming more and more integrated into numerous domains, including political ones. This can be achieved through incorporating AI into climate change mitigation plans and using data analysis to forecast future events. Thus, routine and bureaucratic incompetency in pertinent governmental organizations can be successfully eliminated via AI.

The official entities in charge of managing environmental migrants include local governments and non-governmental organizations. As a result, AI is indispensable to the process of making decisions and forming local policies that address the problems associated with environmental migration.

Conventional techniques for evaluating the environmental conditions frequently lack timely and accurate data.

But AI can analyze enormous datasets, hence producing accurate predictions. AI-driven models, for example, can predict how climate change will affect certain locations, helping politicians better prepare and allocate resources.

AI can increase the accuracy of evaluating climate change effects by up to 30%, per a McKinsey & Company analysis. According to[1], this accuracy is essential for creating focused tactics to counter environmental problems.

7. Utilizing AI to Forecast Weather Conditions

Tornadoes, hail, and thunderstorms are examples of extreme weather events that can seriously harm human settlements and infrastructure, causing financial losses and forced displacement and posing a serious risk to public safety. Better methods of observation and

(1) Shokri Yasmin, 'AI's Eco-Warrior Shaping Sustainable Future', (May 08, 2024), Egyptian Cabinet Information and Dicision Support Center, Link: https://www.idsc.gov.eg/Article/details/9226 accessed 11/7/2024.

computation have helped to lower the likelihood of damage and fatalities from the consequences of climate change.

More attention is being paid to the relationship between the frequency of climate shocks and judgments about migration. A study performed by(1), suggests using a tree-based machine learning (ML) technique to examine how weather shocks affect a person's decision to move in six nations where the economy is built mostly on agriculture: Burkina Faso, Mali, Ivory Coast, Mauritania, Niger, and Senegal. The researchers identified the critical variables and indicated how they are impacting the intention to migrate. The Standardized Precipitation Evapotranspiration Index (SPEI) over various timescales records meteorological shocks, and its ML-based estimator takes these attributes and other socioeconomic factors/covariates into consideration. They found that country-specific model is required; weather features enhance the prediction performance even though socioeconomic characteristics have a greater influence on migration intentions and international migration is more influenced by the longer timescales of SPEIs while general relocation (which includes internal moves) is more influenced by those of shorter timescales.

Even while scientists agree on the basic causes of climate change, it is still difficult to forecast outcomes since earth system models are complex and there is inherent uncertainty in climate change(2). The ability of AI to interpret and gather data considerably reduces the discrepancy between the predictions of digital models and actual circumstances, leading to more precise forecasts of future outcomes(3).

Weather forecasting has become increasingly reliant on artificial intelligence due to the complexity of climate models and the vast amount of data provided by observation satellites. Artificial intelligence is commonly utilized to find new climate models and search for all available information, which improves accuracy and lessens prediction bias(4). The potential of artificial intelligence in weather forecasting is attracting significant attention

(1) J. O. Aoga, J. Bae, S. Veljanoska, S. Nijssen, & P. Schaus, 'Impact of weather factors on migration intention using machine learning algorithms' (2024, January) 8 Cham: Springer International Publishing, In *Operations Research Forum Vol. 5, No. 1.*

(2) G.B. Bonan, S.C. Doney 'Climate, ecosystems, and planetary futures: the challenge to predict life in Earth system models' (2018) Science 359: eaam 8328.

(3) A. McGovern, K. L. Elmore, D.J. Gagne, S.E. Haupt, C. D. Karstens, R. Lagerquist, T. Smith, J. K. Williams, 'Using artificial intelligence to improve real-time decision-making for high-impact weather' (2017), Bull Am Meteor Soc 98, 2073,2090.

(4) N. Jones, 'How machine learning could help to improve climate forecasts' (2017) Nature 548:379.

and will be instrumental in helping relevant departments model data and forecast the economic impact of weather changes. To sum up, artificial intelligence and numerical climate simulation data can be combined to efficiently fill in the observations' data gaps, lowering bias and uncertainty in climate prediction[1].

By employing machine learning algorithms to analyze massive amounts of historical and current weather data, more accurate meteorological models can be developed. Numerous meteorological parameters, including temperature, precipitation, and wind speed, can be predicted with the use of these models.[2]A study comparing three deep learning models—deep neural network, time convolution neural network, and short-term memory neural network—with support vector machines, random models, and empirical equations, [3]computed daily evapotranspiration in the Northeast China Plain. Researchers found that distributed lagged nonlinear models outperform cross-correlation functions in forecasting variable selection and identifying lag effects. However, machine learning techniques outperform nonlinear models utilizing artificial neural networks in the prediction of standardized precipitation evapotranspiration indices.

Solar activity has a major impact on climate change, especially droughts and floods. Artificial intelligence has been utilized by researchers like[4], to enhance the early detection and warning capabilities of solar activity. To be more precise, they have used three-dimensional recognition algorithms to detect drought events in the weather and ecology. These techniques are then used to extract and identify drought events that are spreading by using spatiotemporal overlap rules[5], examining the prediction capacities of AI to predict flood and drought scenarios in arid and tropical areas. Through artificial intelligence, satellites may gather vast amounts of data on land resources from various eras. By comparing this data,

(1) C. Kadow, D.M. Hall, U. Ulbrich, 'Artificial intelligence reconstructs missing climate information' (2020) Nat Geosci 13, 408–413.

(2) Z. Chen, Z. Zhu, H. Jiang, S. Sun, 'Estimating daily reference evapotranspiration based on limited meteorological data using deep learning and classical machine learning methods' (2020) J Hydrol 591:125286.

(3) R. Zhang, Z. Y. Chen, L. J. Xu, C. Q. Ou, 'Meteorological drought forecasting based on a statistical model with machine learning techniques in Shaanxi province'(2019) China. Sci Total Environ 665, 338-346.

(4) T. Jiang, X. Su, G. Zhang, T. Zhang, H. Wu, 'Estimating propagation probability from meteorological to ecological droughts using a hybrid machine learning copula method' (2023) Hydrol Earth Syst Sci 27, 559,576.

(5) K. E. Adikari, S. Shrestha, D.T. Ratnayake, A. Budhathoki, S. Mohanasundaram, M.N. Dailey, 'Evaluation of artificial intelligence models for flood and drought forecasting in arid and tropical regions' (2021) Environmental Modelling & Software 105136, 144.

land planning can become more efficient, and planning schemes more logical and feasible.[1] Machine learning methods have been utilized to leverage ~~to~~ freely available pre-existing data and Sentinel-2 satellite images. Subsequently, using both local and global variables, derived from land use maps, researchers investigated the impact of land use changes on sustainable development.

Ultimately, the more data AI analyzes, the more accurate weather forecasting becomes. So, more precise and timely weather forecasting can lead to enhanced land use efficiency and a reduction in the frequency of weather-related disasters.

8. Challenges Upon Utilizing AI

The first set of ethical risks emerges from the way AI models are designed and developed[2]. The majority of data-driven approaches are trained on existing labelled data as a basis from which to "learn" to cluster, classify, predict, or make decisions regarding new data. This introduces the possibility that undesired bias will enter into the decisions at which an AI system ultimately arrives, raising the possibility of discrimination and unfair treatment of individuals or groups[3]. For example, when attempting to use smartphone data to predict people's travel preferences, it can result in biased decisions if populations with lower smartphone adoption rates are not taken into consideration[4]. These risks are less severe and less numerous when applied to climate change[5]. Addressing climate change necessitates large-scale coordinated action, including systematic changes to individual behavior through helping them visualize its impacts or encouraging them to take pro-environmental actions[6].

A second set of risks relates to the erosion of human autonomy that some climate-focused

(1) HAT Nguyen, T. Sophea, S. H. Gheewala, R. Rattanakom, T. Areerob, K. Prueksakorn, 'Integrating remote sensing and machine learning into environmental monitoring and assessment of land use change' (2021) Sustain Prod Consum 27, 1239,1254.

(2) G. Z. Yang, J. Bellingham, P. E. Dupont, P. Fischer, L. Floridi, R. Full, ... & R. Wood, 'The grand challenges of science robotics' (2018) *Science robotics*, *3*(14), eaar7650.

(3) Y.E. Tao, M. Huang, L. Yang, 'Data-driven optimized layout of battery electric vehicle charging infrastructure' (2018) Energy 150, 735,744.

(4) S. Dabiri, K. Heaslip, 'Inferring transportation modes from GPS trajectories using a convolutional neural network' (2018) Transport Res Part C Emerg Technol 86, 360,371.

(5) A. Tsamados, N. Aggarwal, J. Cowls, J. Morley, H. Roberts, M. Taddeo, & L. Floridi, 'The ethics of algorithms: key problems and solutions' (2021) Ethics, governance, and policies in artificial intelligence, 97,123.

(6) D. Rolnick, P. L. Donti, L. H. Kaack, K. Kochanski, A. Lacoste, K. Sankaran, ... &Y. Bengio,. 'Tackling climate change with machine learning' (2022) ACM Computing Surveys (CSUR), 55(2), 1,96.

AI systems may pose[1]. Finding the right balance between preserving individual autonomy and implementing widespread climate-friendly policies and practices is necessary when implementing encouragement in an environmental context, as there is much disagreement over the impact of such acts on autonomy and whether it inhibits people from making free choices[2]. Relying on AI to combat climate change leads to the risk of violating privacy in addition to autonomy rights and fair treatment. AI systems are unlikely to cause privacy issues to the extent that they use non-personal data, such as meteorological and geographic data, to comprehend the climate catastrophe. However, data that show patterns of human conduct may be necessary to develop measures to decrease emissions, where privacy concerns may be more relevant.

For instance, the effectiveness of AI systems depends on precise data about energy demands, which is frequently available in real time, in control systems intended to reduce carbon footprints in a variety of contexts, such as energy storage[3], industrial heating and cooling (Aftab et al. 2017)[4], and precision agriculture [5]. Sensitive personal information may be present in the data obtained, endangering privacy for both individuals and groups[6]. Recent research highlights this tension by revealing that, although most Europeans (53%) are willing to share their data to help protect the environment, they would only do so under rigorous data protection conditions[7]. AI's application in the fight against climate change does not alone cause any of these challenges. But in this situation, ethical issues raised by AI might take on new shapes, necessitating cautious reactions. Moreover, the expense of computing and the possible effects on the environment that come with creating AI systems bring up additional issues unique to the field of climate change.

(1) L. Floridi, & J. Cowls, 'A unified framework of five principles for AI in society. Machine learning and the city: Applications in architecture and urban design' (2022), 535,545.

(2) A. T. Schmidt, B. Engelen, 'The ethics of nudging: an overview' (2020) Philos Compass 15(4): e12658.

(3) R. Dobbe, O. Sondermeijer, D. Fridovich-Keil, D. Arnold, D. Callaway, C. Tomlin, 'Toward distributed energy services: decentralizing optimal power flow with machine learning' (2019) IEEE Trans Smart Grid 11(2), 1296,1306.

(4) M. Aftab, C. Chen, C-K. Chau, T. Rahwan, 'Automatic HVAC control with real-time occupancy recognition and simulationguided model predictive control in low-cost embedded system'. (2017) 154:141–156 Energy Build.

(5) K. G. Liakos, P. Busato, D. Moshou, S. Pearson, D. Bochtis, 'Machine learning in agriculture' (2018) a review. Sensors 18(8):2674.

(6) L. Floridi, 'Group privacy: a defence and an interpretation' (2017) In Group privacy. Springer, 83,100.

(7) J. Cowls, A. Tsamados, M. Taddeo, & L. Floridi, 'The AI gambit: leveraging artificial intelligence to combat climate change opportunities, challenges, and recommendations *Ai & Society'*, (2023) 1,25.

It is worth mentioning that on September 5th 2024, an international convention on artificial intelligence was signed by the US, the UK, the EU, and other countries. This is the first international treaty with legal force governing the use of AI systems. According to the Secretary-General of the Council of Europe, they need to make sure that the development of AI maintains rather than compromises our standards. Being an open treaty with a potentially global reach, the text called for the ratification of the treaty by those that had already signed it as well as the signing of new nations.

The agreement provides a legal framework covering the entire lifecycle of AI systems, according to a statement from the council. It also manages the threats AI may pose to human rights, democracy, and the rule of law while fostering innovation and advancement in the field.

9. Recommendations and Future Perspectives

The effectiveness of environmental laws must be continuously evaluated and assessed. Studies with a longitudinal design can reveal how environmental governance, legal compliance, and resilience-building initiatives change over time. Researchers can evaluate the effectiveness of policy initiatives and pinpoint areas for improvement by monitoring changes in environmental indicators, catastrophe risk profiles, and community resilience capacities. Future studies should focus on how to include climate adaptation and mitigation measures into environmental laws and disaster risk reduction plans, given the increasing dangers posed by climate change. This implicates planning procedures, regulatory frameworks, and infrastructure spending.

Community-based approaches to climate change should be given priority in future efforts, enabling local stakeholders to actively engage in risk assessments, decision-making procedures, and resilience-building programs. Technological innovations like AI, geographic information systems (GIS), and remote sensing present exciting new possibilities for improving readiness, response, and recovery from disasters. Subsequent investigations ought to delve into the possibilities of these technologies in enhancing early warning systems, risk mapping, decision support tools, and assessments conducted after a disaster. Researchers can provide novel approaches to new problems, like data-driven decision-making tools for practitioners and policymakers, predictive modelling of disaster impacts, and real-time monitoring of environmental indicators.

Different situations can be analyzed and compared, such as countries' environmental laws, regulatory procedures, and resilience-building tactics. Moreover, procedures should be provided for the ethical auditing of AI systems employed in high-stakes climate change scenarios where the usage of personal data and/or the influence on individual conduct are possible.

To improve research transparency, help the field align on metrics, and effectively communicate carbon footprints, develop carbon assessment and disclosure standards for AI. One way to do this is by adding carbon labels to AI-based technologies and models that are listed in online libraries, journals, and leaderboards. By using these labels, developers and researchers would be able to choose models, hardware, and cloud providers for their projects while also making decisions that are environmentally conscious.

10. Conclusion

In conclusion, this study gives an overview of the international environmental laws existing currently and presents a comparative analysis concerning the differences between regional environmental legislations. It also emphasizes how artificial intelligence development can help in tackling environmental migration. It is now more important than ever to apply artificial intelligence in the field of environmental migration to handle potential problems and prevent new ones from arising. This is especially important in light of the potential limitations of human competence in terms of AI's facilitation and aspirations. Although AI has been suggested by many as a solution to sustainability and environmental problems, AI has a large carbon footprint. The physical components of AI and the resources extracted to build them, as well as the enormous energy costs associated with running data centers, are some of the causes of this. This essay examines the basic problems and difficulties—including legal and human rights implications—that might emerge from applying AI in the context of environmental migration.

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