Topic: Mobility as Climate Change Adaptation in South Africa: Exploring the legal and

policy significance of Artificial Intelligence.

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Abstract

The increasing reality of mobility linked to adverse impacts of climate change highlights an urgent need for nuanced and systematic research around climate mobility. While mobility is often used as a coping or adaptation strategy to escape climate impact, some mobility typifies and results in maladaptation. Protecting populations in vulnerable situations usually raises issues that test the limits of law and policy on mobility as an adaptation to climate change. Artificial Intelligence (AI) is used to improve life and livelihood but has downsides. South Africa has a fair share of mobility associated with extreme climate change events. Still, the extent to which AI applies in the context of climate mobility and adaptation is undeveloped. It is even less so examined whether AI may aid or hinder the protection of populations relocated as an adaptive measure in response to adverse consequences of climate change in South Africa. Consequently, this paper explores the intersection of human mobility, climate adaptation, and AI in South Africa, focusing on key provisions of existing legal and policy instruments that may be leveraged to address issues involved in protecting populations experiencing climate change-induced displacement. In doing so, it assesses AI's potential role in the IDPs' planned relocation, for example, using AI tools for needs assessment, resource allocation, protection services, or infrastructure planning. It also proposes that with AI policies and laws, mitigation against maladaptation and effective adaptation to climate change impact can be attainable in South Africa.

Keywords: Human mobility, climate adaptation, AI, Law, maladaptation, planned relocation.

1. INTRODUCTION

According to the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (IPCC AR6), "climate change is a growing driver of human mobility, with increasing frequency and intensity of extreme weather events like floods, droughts, and storms leading to significant displacement of people globally, particularly in regions with high vulnerability and low adaptive capacity"(1-4). While mobility is often used as a coping or adaptation strategy to escape climate impact, some mobility typifies and results in maladaptation. As such, climate mobility and adaptation of displaced persons, in this context, Internally displaced persons (IDPs) require an urgent need for nuanced and systematic research(5-8). This paper argues that AI can aid climate mobility and help reduce maladaptation and create effective relocation programmes. In this paper, "climate mobility" refers to different types of human movements in the context of climate change: migration, forced displacement and planned relocation(9, 10). Although contested, this form of human movement is usually attributed to natural disasters such as earthquakes and tsunamis, an error that needs to be eschewed. Ian Fry, the former United Nations Special Rapporteur on the promotion and protection of human rights in the context of addressing this misconception, submits in his report to the United Nations Human Rights Council that "people displaced by climate change should be considered legally and procedurally different to those affected by geological disasters"(11) Likewise Caitlan(12), Gemenne (13)McAdam, Kalin(14) just to mention a few are international lawyers and experts on climate change who have argued for a legal status and distinct legal framework for climate displaced persons. Climate change impacts people globally compared to natural disasters, which might be limited to geographical space. Hence, construing

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displacement in the context of climate change is essential as it has implications on historical causality and international responsibility regarding climate change displaced persons.

According to the IPCC report on Impacts, Adaptation and Vulnerability (15), climate change impacts may broadly be divided into two categories: the sudden or rapid onset events (floods, storms, heatwaves and wildfires)(11, 15, 16) and more gradual changes or slow onset events (coastal erosion or drought, sea level rise, desertification, or ocean acidification)(17) (18). The Report further shows that slow onset events in the form of ecological droughts increase the risks of wildfire, which can lead to human displacements and loss of social ties, sense of place and cultural identity, and migration(17). The United Nations High Commissioner for Refugees has stated that climate mobility encompasses a range of mobility types, such as forced displacement or involuntary immobility, as well as potentially positive types, including autonomous, high agency migration and planned community-led relocation, which can be a good form of adaptation strategy(11, 19).

In South Africa, the mobility of IDPs has mostly taken the form of historical forced displacement under the apartheid regime(17), forced displacement due to climate change (18) and xenophobia as a result of clamor for scarce resources(20). This research focuses on the adaptation of climate-displaced persons (IDPs) due to sudden or rapid onset events caused by climate change, emphasising the use of AI for planned mobility and adaptation/relocation of climate IDPs into their new environment. However, evidence suggests that climate adaptation may subsequently lead to a form of maladaptation in Africa, a process through which people become even more vulnerable to climate change (21). For example, measures aimed at assisting the IDPs to cope

with displacement associated with climate sudden and slow onsets in South Africa sometimes expose them to rape, extortion, internal conflict for resources and overcrowding. (21).

Maladaptation may include infrastructural maladaptation (20, 21), institutional maladaptation (22) and behavioural maladaptation (23); however, according to the IPCC 2022 Report " poor planning is consistently identified as a primary cause of maladaptation to climate change, depicting how deficient relocation/adaptation strategies can worsen vulnerabilities or create new risks, especially for marginalised communities"(17). Hence, planning should also be engaged from the onset of mobility to the relocation and reintegration into a new community or previous habitat. As a result, this study aims to uncover the legal implications of the role of AI as a climate technology for adaptation in South Africa. As such, the study attempts to answer the following questions.

1. What are the adaptation gaps and potentials in response to climate mobility?

2. Can the deployment of AI address maladaptation to climate mobility?

3. Can the existing legal framework aid the regulation of AI as a climate adaptation tool?

4. How may regulatory measures from other legal systems inform or improve AI as a climate adaptation strategy in South Africa?

2.   IMPACT OF CLIMATE CHANGE ON MOBILITY IN SOUTH AFRICA

According to the Internal Displacement Monitoring Center (IDMC), between 2008 and 2023, there were 232,000 displacements in South Africa due to 70 sudden onset events ranging from flooding, wildfire, and storms (22). On the 23rd of September 2024, heavy

snowfall caused significant disruptions in provinces including KwaZulu-Natal, Free State and Eastern Cape, leaving motorists stranded for two days in their vehicles in the N3 without speedy intervention by the government. The KwaZulu-Natal authorities later confirmed that a woman died because of hypothermia because of the extreme weather conditions(23). Earlier in July 2024, it was reported that approximately 15,000 people were displaced because of a storm in the Western Cape (24). While thousands of the displaced found shelter through NGOs, relatives, and friends, some have returned home, depending on the severity of their circumstances. In the same month of July, a total of 53 people were displaced due to wildfire in Eshowe, KwaZulu-Natal (24), and because of stormy weather in Cape Town, 5000 persons were displaced. In the Western Cape, Ward 99 in Khayelitsha was 'taken out' by excessive gale force winds, simultaneously causing mayhem in six informal settlements, damaging 1,000 informal homes and displacing 4,000 residents in icy cold and pouring rain(25). In June, over 2000 people were displaced from their homes due to heavy flooding in Masiphumelele, Bloekombos and Khayelitsha, in Cape Town (26). At the same time, it was reported that Tornado resulted in more than 1200 people being displaced in Tongaat, KwaZulu-Natal. Those affected were placed in shelters(27). Nelson Mandela Bay Metropolitan Municipality also had about 3,360 displacements in June, and more than 1000 households were displaced due to floods (28). Human Settlements Minister Mmamoloko Kubayi declared urgent relocation of families currently housed at mass care centres to temporary emergency accommodation, including safer places for mothers and small children, as an immediate action and temporary residential units as a medium to long-term intervention(29). According to the water and sanitation department, over 110 households were displaced

due to stormy weather in Margate, Uvongo, Shelly Beach, and Port Edward (30). Incidents of displacement are reported in Cape Wine Lands District Municipality(30), while approximately 1000 people were homeless due to a storm on 6 April in Stellenbosch(31).

South Africa's adaptation policy response to the climate crisis is its "National Climate Change Adaptation Strategy (NCCAS)", a comprehensive plan that outlines priority areas for addressing climate change impacts through initiatives like early warning systems(EWS) and community awareness campaigns (32). For example, the IPCC Report indicates that the Cape Town case demonstrates the importance of integrating state and non-state responses to climate change in municipal adaptation and disaster planning, particularly for reactions with unintended consequences(17). Evidently, according to IDMC(22) and the 2024 report on Climate change impacts in South Africa, (33) people affected by sudden onsets of climate change between April 2022 –August 2024 relocated due to the destruction of their homes and essential facilities. The climate IDPs were subsequently either sheltered in churches, schools, and community halls or shared homes with relatives and friends(26, 27, 34, 35). This development predisposes them to human rights abuses such as exploitation, rape, gender-based violence, limited access to education and loss of cultural identities(36).

3. ADAPTATION GAPS IN RESPONSE TO CLIMATE CHANGE IMPACTS

3.1. Gaps in Climate Adaptation and Disaster Risk Management

The South African government has taken steps to address the plight of climate IDPs and has been supported by Non-Governmental Organisations (NGOs). Yet, there are gaps in the adaptation strategies that require urgent attention. Emphasising the gaps in climate

adaptation, the United Nations Environment Programme (UNEP) 2023(37) Identifies adaptation gaps in the form of inadequate investment and planning on climate adaptation. In South Africa, based on the experience at the KZN, South African President Cyril Ramaphosa, on 18 April 2022, declared a national state of disaster due to the sudden onset events that occurred in the region and made commitments in collaboration with the provincial and municipality structures to address the climate crisis.(32). The national government planned to address the climate crisis in three phases: offering immediate humanitarian assistance to climate IDPs to cater for their basic needs, which are shelter, health and education, and rehabilitating climate IDPs and damaged infrastructures (38). Finally, the third phase was to rebuild significant infrastructures ranging from critical water and sanitation facilities to vital road networks and bridges. (38).

An overview of the government's response to the first plan revealed that the IDPs were sheltered in community halls and provided with mattresses, food, and hygiene packs(39). The KZN premier, Sihle Zikalala, committed to building 4,396 temporary accommodation units by the end of April 2022 (40). According to the Premier, 6 278 people have been left homeless, 17 438 households were affected by the disaster, and 121 687 people were affected (40). 7,490 people live in shelters in eThekwini, KwaDukuza, and Umzumbe. During the period, ninety-eight shelters accommodated 8 400 people; 1 700 were children under ten, and 217 were persons with disabilities (35). It was further reported that in September 2022, an additional 100 climate IDPs joined the IDP group of April(36) with less humanitarian relief. The climate IDPs complained to the media about their plight about the sexual exploitation of their children, exposure to alcohol and drug abuse, lack

of privacy in the bathroom and unique spaces, exposure to extreme cold during the winter period and constant clashes of limited resources. The children had no access to education(36). Although the healthcare givers were visible, their activities were reactive rather than proactive to their plights. In response to the complaints of the climate IDPs, in August 2022, the State's Ad Hoc Joint Committee on Flood Disaster Relief and Recovery paid a courtesy visit to some shelters in KZN and uncovered that the shelters were overcrowded and that the climate IDPs lived in inhumane conditions(41). In response to the climate IDPs' allegations of lack of food, basic needs and inhumane living conditions, the government blamed some individuals amidst the climate IDPs for being greedy to have taken more than their daily ration and promised to address their plight. The government pledged to intensify their efforts to ensure that the climate IDPs, especially children with disability, had access to education, health care and protection from social vices(42). However, in September 2022, hundreds of children in shelters were still not attending school when UNICEF South Africa provided relief through recreational toys and learning materials to the children(43). In response to the allegation, the Department of Human Settlements restated its commitment to move IDPs out of shelters into accommodation units by December 2022 (44).

As a result of the plight of Climate IDPs in South Africa, this paper argues as would be discussed in latter sections, that Climate change adaptation strategy and disaster risk management Act in South Africa, portray gaps in law and practice, especially in providing shelters, health care and education. As indicated by the IDPM reports, IDPs have and are

still housed in churches, schools, and community halls. As such, the government lacked the technical know-how and experience to manage the influx of IDPs (22).

3.2. Gaps in Climate Adaptation and Risk Reduction Technology

The IPCC special report on global warming of 1.5°C(SR15)(45) , IPCC Climate Change 2022 report (17) and the IPCC Climate Change 2014 Report on Mitigation of climate change (46) highlight and recognise the role of EWS in supporting climate mobility and adaptation. To adapt to the impact of climate change, the UNFCCC recommends using climate technology, including EWS.(47, 48). With the use of EWS as a climate mobility and adaptation tool, the South African Weather Service (SAWS) currently utilises an Impact-Based Severe Weather Warning System (ImpB-SWWS) intended to warn the general public of possible climate impacts, shifting from the traditional Severe Weather Warning System (SWWS) (49). Although an ImpB-SWWS may inform people of the impending climate crises and indicate the level of impact such crisis may cause, the missing link or gap identified with the use of the ImpB-SWWS is the operational speed, length of forecasting period, forecasting accuracy, the dissemination process, response capacities and preparedness to address the climate crisis(50-52).

Re-affirming the technology gaps for climate EWS and adaptation, the UN Secretary-General, António Guterres, in 2022, during COP 27, called for a global effort to ensure that EW4All on Earth by 2027 set out four Pillar initiatives for an effective climate EWS and adaptation, which are to be implemented by different organisations (53). These pillars are examined in the ensuing subsections.

3.2.1 *Pillar 1- Disaster risk knowledge*

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While tasked with the mandate to implement Pillar 1 of the EW4ALL initiative, the United Nations Disaster Risk Reduction (UNDRR) uncovered significant gaps in terms of risk information and assessments worldwide in that "less than half of the countries with existing EWS have access to appropriate disaster risk information, and even fewer have national legislation and regulatory frameworks for emergency response"(53). An overview of South Africa's response to the Pillar 1 initiative demonstrates that the country indeed has an EWS and has a couple of disaster management frameworks, such as the Disaster Management Act of 2002 and the National Climate Change Response (NCCR) policy. Nevertheless, as will be discussed in the latter section, the EWS and the regulatory frameworks are fraught with gaps and inept implementation processes. To address the gap, Pillar 1 aims to boost global risk knowledge and incorporate it into EWS, advancing stakeholder coordination innovation and empowering decision-makers and vulnerable communities to understand, identify, and respond to climate risks.(53).

3.2.2 *Pillar 2- Detection, observations, monitoring, analysis and forecasting of hazards.*

Pillar 2, led by the World Meteorological Organization (WMO) and other cohorts, aims to shed light on the evolving nature of climate change so that governments, communities and individuals can be prepared and respond to the climate crisis.(54). To actualise this end, it is suggested that the EWS must be human-centric, affording humans ample time and opportunity to prepare and respond to the climate crisis. (54). An evaluation of South Africa's performance on Pillar 2 is brought to light by the recurrence of climate crises in KZN, Western Cape and the environs. The reoccurrence of climate crises and the inept ability to manage them depict much needs to be done. As indicated in the former sections

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and would be emphasised in Pillar 4, SAWS currently utilises an Impact-Based Severe Weather Warning System (ImpB-SWWS), which is not adequate for early detection, observations, monitoring, analysis and forecast which will aid viable response to climate crises. For example, the ImpB-SWWS may inform people of the impeding climate crises and indicate the level of impact such crisis may cause, the missing link or gap identified with the use of the ImpB-SWWS is the operational speed, length of forecasting period, forecasting accuracy, the dissemination process, response capacities and preparedness to address the climate crisis.(49-52)

3.2.3 *Pillar 3: Warning dissemination and communication*

Next in line amongst the pillars is the systematic warning strategy and communication of climate risk to individuals and communities. This initiative was led by the International Telecommunication Union (ITU)(55, 56). The ITU identified dissemination and communication gaps in EWS and gaps in the legal frameworks, which can help facilitate the dissemination of information.(55). In response to these gaps, it was suggested that dissemination of information is not a 'one-size-fits-all approach'(55); hence, each member nations, depending on their financial capability, address their communication gaps by strengthening existing community-based infrastructures and locally led feedback mechanisms such as radio, television, social media, sirens, mobile phones, and satellite.

Regarding disseminating weather warnings in South Africa, SAWs mainly use radio and television to convey warnings of impending climate hazards.(57, 58). Although television and radio are valuable means of dissemination, SAWs have yet to thoroughly utilise mobile communications as recommended by the ITU.

3.2.4 *Pillar 4: Preparedness to respond.*

Led by the International Federation of Red Cross and Red Crescent Societies (IFRC), Pillar 4 evaluates how governments, non-governmental agencies, communities and individuals respond to the climate crisis.(59). An anticipatory response to a climate crisis refers to actions taken before a predicted crisis occurs to prevent or reduce its potential impacts.(59). Examples of these actions include early evacuation, reinforcing homes, distributing health protection kits, setting up mobile cooling centres and distributing cash.(60, 61). According to the IFRC, most government and NGO agencies have planned and given humanitarian support after the climate crisis. At the same time, there are existing EWSs that can forewarn all stakeholders of the impending crisis.(59, 62). As a result, while the agencies are busy analysing the needs assessments, drawing up response plans and sourcing funds after the crisis, people affected by the climate, having gone through the emotional shock of seeing their lives and livelihoods in chaos, would have to go through another strain accessing necessary support.(59).

In sum, juxtaposing South Africa's existing adaptation and risk management strategies with the findings and recommendations of the four Pillars of the EW4LL initiative reflects the following: 1. It might be argued that South Africa does have in operation the combination Pillar 1,2 and 3, as warning system which can monitor and predict climate hazards, communicate its impact, and disseminate climate hazards to communities and the country. However, the point often overlooked is the word "early detection". Although South Africa has a warning system, as previously indicated, it is not viable for early planning, implementation of evacuation and relocation of IDPs for example while other EWS such as FuXi-Subseasonal model, has the capacity to significantly increase the

prediction period for extreme weather from 30 days to 36 days, predicting potential climate disaster events as early as possible, and gaining more time for response and mitigation measures(63, 64) . According to SAWs report(51), SAWs release 7-day forecasts which might not be sufficient for South Africans to plan and respond to impending climate crisis. As such, according to the SAWs report for 2023/2024, early warnings of a Snowfall that occurred from 8 to 10 July over the Western Cape to western cape and KZN on the 9th of July and then to Mpumalanga and then to the southern and central parts of Gauteng on the 10 July 2023 was only issued by SAWs on the 8 July 2023 through the media(49).   Similarly, early warning systems for the Stormy weather that occurred over central, southern, and eastern parts of South Africa on the 23 to 26 December was only issued on the 22nd of December 2023(49). As it stands, relying on the existing early warning system will make it a mammoth task to plan the mobility and relocation of the IDPs compared to other climate technology that can issue early warnings up to 30 to 36 days. It is worth noting that there might be instances wherein the communities might resist evacuation or relocation; concrete plans and policies should have been implemented to encourage relocation or justify their actions/inactions if the community or individual would suffer harm due to the climate hazard. Petteri Taalas, the Secretary-General WMO, in the Executive Action plan for 2023-2027, indicated that "Early warnings save lives and provide vast economic benefits", with just 24 hours' notice of an impending hazardous event, having the potential to cut the ensuing damage by 30 per cent" (53). The Global Commission on Adaptation found that spending just $800 million on such systems in developing countries would avoid losses of $3-16 billion per annum"(56).

The approach in South Africa lacks Pillar 4, representing a significant gap in the climate adaptation and risk management strategies in South Africa. As alluded to by the IFCR, although the government and NGOs extend humanitarian assistance to support individuals and communities affected by disasters, the support would be more effective if well-planned before climate hazard. For example, in most cases of climate change-related displacement in KZN and its environments, the IDPs have in most cases been relocated to religious houses, community halls, schools, shacks and or places that are dehumanising. As indicated in the previous sections, IDPs have complained bitterly about their state of health care and the living conditions after their relocation and settlement. In 2022, as indicated in the previous sections, the government had promised to build 4 396 temporary accommodation units by the end of April 2022 due to the dehumanising state of the IDPs and the report of the State's Ad Hoc Joint Committee on Flood Disaster Relief and Recovery. Evidently, in the year 2024, climate change IDPs are still housed in shelters with limited food supplies and are prone to all sorts of criminal vices, such as rape, drugs, and gender-based violence, just to mention a few, due to feeble planning. Hence, as indicated in the previous sections, the ordeal individuals and communities must endure while in transit or adapting to their unfamiliar environment is dehumanising and thought-provoking. Hence, the IFCR, the pains and neglect individuals and communities go through while in transit and trying to adapt to their new environment, can be mitigated by having the proper early warning climate technology to address climate change and associated crises (60).

4. AI EWS AS POTENTIAL CLIMATE CHANGE ADAPTATION TOOL

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AI is the simulation of human intelligence in machines to think, learn, and perform tasks that typically require human intelligence (65). The IPCC AR5 (4) IPCC (SR15)(45) and IPCC Special Report on Climate Change and Land(SRCCL)(66) highlight the importance of AI EWS as a key climate adaptation technology which can aid the reduction of climate-related disasters. AI has been projected to be capable of performing tasks such as problem-solving and planning for effective climate adaptation (67, 68). Aside from early warning and climate impact estimates, governments and NGOs such as the Red Cross and Gift of the Givers are considering AI's potential for simulating responses to various climate emergencies to aid climate adaptation in response to Pillar 4 of the EW4LL initiative (69, 70). This connotes that AI can play a significant role in climate adaptation, such as support from Earth Observation to identify accessible roads during disasters such as floods, humanitarian efforts in identifying the most vulnerable and conducting a need assessment, resource allocation to help allocate resources which is one of the main concerns in climate adaptation.

Also, as an adaptation tool, AI can improve shelter planning for short- and long-term adaptation strategies. AI tools, such as AI-driven smart home systems(AIDSHs), can reduce energy usage by adjusting home appliances and monitoring and controlling lighting, temperature, security and air conditioners to adapt to extreme weather. (71, 72). The AI system suggests energy-efficient appliances that users may use to adjust/adapt to any potential climate hazards comfortably,(73, 74) predicts maintenance schedules for appliances for optimum usage,(75, 76) optimises water distribution from the water grill, detects and minimises leaks and waste(77, 78), and or used as smart electricity grids, which are capable of conserving energy and aiding adaptation to climate risk(79).

As such, this paper argues that AI systems can aid in IDPs' effective adaptation and resilience in a new environment through AI EWS and climate AIDSHs(80). While there are growing concerns that the government build an accommodation for the IDPs, it is a good opportunity for the government to make an AI innovative–home community where climate change IDPs will be housed rather than churches, township halls or squatter camps. The intelligent- home systems, integrated with other technological systems, such as biogas, can effectively manage human waste, which will be converted to energy for cooking and warmth during winter. AI inculcated in the building plan can also help regulate temperature, monitor unsolicited activities, and pre-empt heinous crimes such as rape, and drug peddling, which are issues of great concern to the IDPs. AI systems can also help educate the children of the climate change IDPs at the centre through video and interactive learning. Through AI, transmitted viral diseases such as COVID-19 (81) can be easily identified and treated. AI can also assist with administrative healthcare work(82).

4.1 **Good practices on AI as a response to climate adaptation management gaps**

a. **AI EWS**

Recently, scientists have unveiled climate AI technologies such as Sub-seasonal forecast tools. (63, 83), FengWu-GHR (84), Pangu-Weather(85) and GraphCast(86) that can predict potential climate sudden onset events as early as possible, thereby proffering more time for response for mitigation and adaptation (84). Comparing these AI technological tools with the existing SAWs, EWS portrays a significant gap in the prediction and accuracy in the detection of climate sudden-onset events. According to the SAW report(51), SAWs release 7-day forecasts, which might not be sufficient for South Africans to plan and respond to climate risk or sudden onset events. For example,

according to the SAWs report for 2023/2024, early warnings of a Snowfall that occurred from 8 to 10 July over the Western Cape to Western Cape and KZN on the 9th of July and then to Mpumalanga and then to the southern and central parts of Gauteng on the 10 July 2023 was issued by SAWs on the 8 July 2023 through the media.(49). Similarly, early warning for the stormy weather that occurred over central, southern, and eastern parts of South Africa on the 23 to 26 December was only issued on the 22nd of December 2023(49). As it stands, relying on the existing SAWs EWS will make it a mammoth task to plan the mobility and relocation/adaptation of the IDPs compared to other climate technologies that can issue early warnings up to 30 to 36 days ahead of the climate hazard.

b. AI Climate Adaptation Management Tools

As indicated, AIDSH systems can be used to plan IDP shelters/accommodations to aid in better climate adaptation. The AIDSH system may be used as smart electricity and water grids to manage heat and light appliances to conserve energy, helping a resilient adaptation.(79). Examples of such AIDSH systems are LG's Smart ThinQ, Daikin's Altherma, Carrier's Cor, Ariston'Net, Rheem's EcoNet and Stiebel Eltrons SENZ, to mention a few. Other AI climate adaptation tools, such as GeoMarch(87) and EUMigraTool(88, 89) Although used in the context of mobility and relocation of refugees, it can also help manage human mobility and adaptation and resettlement of IDPs in South Africa. These AI tools prevent maladaptation to the new environment by avoiding overcrowding, facial recognition, aiding food and water distribution in resettlement camps, tracking and gathering data on the IDPs, capturing illegal activities such as rape, drug peddling, gender-based violence and other vices to aid easy prosecution.

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The above AI algorithm tools will go a long way in aiding the management of IDPs in South Africa. It has been reported in South Africa that while IDPs were relocated temporarily to churches, schools and community halls, the IDPs, more often than not, they were exploited, humiliated, and exposed to different vices(36, 41). As a result of the foregoing, this article suggests that AI has the potential to address the challenges faced by the South African government in managing effective adaptation. For example, AI EWS can aid climate mobility and adaptation regarding IDPs in KZN.(90).

This article is not oblivious to the legal implications of deploying AI as an adaptation tool, such as liability and accountability, should the AI system cause harm or make adverse decisions that have unintended harm. Other challenges of deployment of AI for mobility and adaptation purposes are bias, invasion of privacy, security issues and the potential contributor to GHG emissions(91, 92). As it stands, the amount of future GHG emissions from AI computing infrastructure is unclear. Nevertheless, as AI is developed and deployed responsibly, there are tendencies in the future that developers of AI will develop energy-saving AI tools just like energy-saving bulbs. Only time can tell what the future holds for AI as a climate technology tool. As such, there is a need for a regulatory framework for the development and deployment of AI in South Africa to safeguard the future.

5. POTENTIAL IN KEY REGULATORY FRAMEWORKS IN SOUTH AFRICA

As AI technologies continue to evolve and permeate human lives and livelihood, this paper argues that AI can be used to aid climate adaptation. Although none of the existing international instruments nor domestic instruments have made specific reference to AI as a climate adaptation technology, this paper argues that in principle, both international and

domestic instruments tacitly or expressly support the use of AI in aiding climate adaptation.

i. The UNHCR Guiding Principles on IDPs (UNGP)

The UNGP is a piece of international instrument that identifies the rights and protection of IDPs. It also aids the IDPs in all mobility, relocation, and social reintegration phases. Although the Principles are not binding instruments, they reflect and are consistent with international human rights such as civil and socio-economic rights. It may also be argued that the UNGP currently forms part of customary international law(93). The UNGP(94), defines IDPs as;

> persons or groups of persons who have been forced or obliged to flee or to leave their homes or places of habitual residence, in particular as a result of or to avoid the effects of armed conflict, situations of generalised violence, violations of human rights or natural or human-made disasters, and who have not crossed an internationally recognised state border.

Principle 3, read with 7(2), 8,18, and 23 of the UNGP, places a burden on the government to protect and provide humanitarian services and proper accommodation for the IDPs and that governments should ensure that such displacement should not violate the civil and socio-economic rights of those affected. Also, the 1992 UNFCCC(95), UN Paris Agreement 2015(96) and the United Nations Development Programme on climate change adaptation(97) emphasised the need for climate justice and shared responsibility in addressing climate change. Hence, this paper argues that countries that are historically responsible for climate change and its consequences should lead in providing necessary

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services. Even if it is argued that the UNGP principles are not binding, they conform to international human rights obligations, which suggest that states must respect, protect, promote, and fulfil progressively socio-economic rights. South Africa is a signatory of socio-economic rights and, hence, is obliged to respect the socio-economic rights of IDPs to access education, health care, and housing during mobility and adaptation.

Although the UNGP has no specific reference to AI as a potential technology to achieve the content of the UNGP, nevertheless, in principle, it can be argued that the UNGP supports the use of AI. For example, one of the primary uses of AI in the context of sudden-onset climate events is to facilitate climate adaptation and enhance the protection of IDPs. It may be argued in the context of the provisions of the UNGP that AI can be deployed in a manner that would aid the actualisation of IDP rights.

For example, Principle 7 connotes that.

> 1. Before any decision requiring the displacement of persons, the authorities concerned shall ensure that all feasible alternatives are explored to avoid displacement altogether. Where no other options exist, all measures shall be taken to minimise displacement and its adverse effects.

> 2. The authorities undertaking such a displacement shall ensure, to the greatest practicable extent, that proper accommodation is provided for the displaced persons, that such displacements are effected in satisfactory conditions of safety, nutrition, health and hygiene, and that members of the same family are not separated.

In context, principle 7 purports that state institutions and authorities explore feasible alternatives to avoid displacement, which might have never occurred if the right

technology was deployed. As such, the UNGP suggests in its totality the use of the latest technologies such as AI EWS and AI tools which can aid climate mobility and resettlement of IDPs. As a result, it is suggested that AI- informed climate mobility initiatives and laws in South Africa should prioritise the protection of IDPs' right to life, health and medical care, adequate food, shelter, security, dignity, violence and any form of discrimination and exploitation using AI technologies.

ii.   The African Convention on the Protection and Assistance of Internally Displaced Persons in Africa (Kampala Convention) of 2009

The Kampala convention(98) Is yet another international instrument that aims to cater to IDPs' needs. Article V of the Kampala Convention, like the UNGP, obliges States Parties to protect and assist IDPs. Although South Africa is not a signatory of the Kampala Convention, the government is bound to protect its citizens and fulfil their fundamental human rights regardless of their state as displaced persons.

Article IV refers explicitly to EWS technology to mitigate the impact of climate change. Article IV provides that;

> The States Parties shall devise early warning systems, in the context of the continental early warning system, in areas of potential displacement, establish and implement disaster risk reduction strategies, emergency and disaster preparedness and management measures and, where necessary, provide immediate protection and assistance to internally displaced persons;

In other words, scientific evidence has suggested that AI technology can be used as EWS and aid preparedness and management of climate crisis.(99), it is paramount that state

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governments and Institutions use AI technology to actualise the provisions of the Kampala Convention.

iii. International Covenant on Economic, Social and Cultural Rights (ICESCR):

Socio-economic rights are the second generation of rights which originate from the (ICESCR)(100). Articles 11,12 and 13 of the ICESCR(101) recognises everyone's fundamental rights, such as housing, health, and education, respectively and obliges the state to take appropriate steps to achieve these rights.(102) These rights are adopted and enshrined in the South African constitution. The purpose of engraving these rights in the South African constitution is to allow the government to formulate policies towards the actualisation of socio-economic rights, which will equip courts to intervene when such rights are infringed upon or implemented unsatisfactorily. In theory, these rights allow citizens of signatory Nations, climate change IDPs included, to inter alia demand basic socio-economic rights from the government.

Although the ICESCR does not specifically refer to AI technology in its provision, it can be deduced that the provisions are intended to imply the use of AI technology to actualise the rights of IDPs. For example, Article 15(1) provides that States Parties to the present Covenant are to recognise the right of everyone to enjoy the benefits of scientific progress and its applications. The ICESCR encourages the use of science, which arguably includes AI technologies, to achieve the full realisation of socio-economic rights, such as the right to adequate housing, health care, education, water and social security, just to mention a few. The CESCR's General Comment No. 25, issued in 2020(103) and the

International Justice Resource Center (IJRC)(104) respectively "clarifies that individuals have the right to not only benefit from scientific progress but also to actively participate in it".

iv.   The South African Constitution

Moving to domestic instruments, the South African constitution is one of the most profound and progressive constitutions in the world, being that it is founded on dignity, equality, and freedom. These rights are also extended to IDPs as they are citizens of South Africa. The government, in terms of the constitution, is obliged to respect and protect the dignity and the actualization of IDP's rights to proper housing, education, and a clean and healthy environment. Sections 24,26,27 and 29 Constitution(105) respectively provide as follows;

(1) "Right to an environment that is not harmful to their wellbeing and to have it protected for the benefit of present and future generations".

(2) "Right to have access to adequate housing, which the government must take reasonable legislative and other measures within its available resources to achieve the progressive realisation of the right".

(3) "Right to health care, water and social security".

(4) "Right to education".

However, the inclusion of the rights to health, education and housing in the constitution often does not translate into action, especially in the context of IDPs. Hence, this paper argues that the government should provide the IDPs with basic rights when displaced by developing AI systems that support climate change adaptation efforts will aid the actualisation of the above rights mentioned. South African government is a signatory to

socio-economic rights and is bound to fulfil measures that will enable IDPs to enjoy socio-economic rights, including using technology such as AI to promote environmental education, security, and access to basic health care and information. The CESCR's General Comment No. 25 (103) also prescribes that States parties should ensure that everyone has equal access to science applications, particularly when they are instrumental for the enjoyment of other economic, social and cultural rights. In sum, states are to ensure that AI technologies and tools to address climate crisis are human-centric and prioritise fundamental rights

v.   South African Disaster Management Act (DMA)

The primary aim of the DMA(106) is to establish a comprehensive, integrated, and coordinated disaster management framework intended to proactively address climate risk, mitigate climate disasters, and aid post-disaster recovery by establishing national, provincial and municipal disaster management centres. While the DMA does not explicitly mention climate change IDPs in its provision, it can be argued in terms of section 27 (1)(2) of the DMA, read with sections 24, 26,27 and 29 of the South African constitution that the government must provide the basic needs of the IDPs. This paper argues that the basic need and rights of IDPs include the use of latest technologies to address the climate change crisis, adaptation and maladaptation as a result of climate mobility. Section 27 of the DMA provides that in the event of a national disaster, the Minister may declare a national state of emergency, and if such is declared, consult with the responsible Cabinet members to make regulations or issue directions or authorise the issue of directions concerning,

(a) the release of any available resources of the national government, including stores, equipment, vehicles and facilities;

(b) the release of personnel of a national organ of state for the rendering of emergency services;

c) the implementation of all or any of the provisions of a national disaster management plan that are applicable in the circumstances;

(d) the evacuation to temporary shelters of all or part of the population from the disaster-stricken or threatened area if such action is necessary for the preservation of life;

(e) the regulation of traffic to, from or within the disaster-stricken or threatened area;

(f) the regulation of the movement of persons and goods to, from or within the disaster-stricken or threatened area;

(g) the control and occupancy of premises in the disaster-stricken or threatened area;

(h) the provision, control or use of temporary emergency accommodation;

(i) the suspension or limiting of the sale, dispensing or transportation of alcoholic beverages in the disaster-stricken or threatened area;

(j) the maintenance or installation of temporary lines of communication to, from or within the disaster area;

(k) the dissemination of information required for dealing with the disaster;

(l) emergency procurement procedures;

(m) the facilitation of response and post-disaster recovery and rehabilitation;

(n) other steps that may be necessary to prevent an escalation of the disaster, to alleviate, contain and minimise the effects of the disaster, or

(o) steps to facilitate international assistance

It is worth noting that, as previously discussed, the entire sub-paragraphs are issues that the IDPs in KZN have complained about, and to this day, the government has not taken necessary measures to fulfil sub-section (m)(n) and (o). In other words, sequel to the summations made with regards to the potential of AI as a climate mobility and adaptation technology, this paper argues that the sub-section 'm' may be read to utilise AI EWS in the facilitation of response to climate crisis and as a disaster risk management to address post-disaster recovery and rehabilitation. As such, sub-section "n" should be read as taking steps such as integrating AI into other technologies like smart home systems and Bio gas technology. Taking such steps is crucial to prevent maladaptation. Finally, sub-section "o" as described should be read that the minister in cohort with other cabinet members or climate change experts should seek ways to facilitate international assistance for the development and deployment of AI for climate mitigation and adaptation. Hence the Minster and cohort aside sourcing funds locally should take a bold step to engage those who were historically responsible for the current climate change and its consequences, to support and aid AI as a climate mobility and adaptation technology in South Africa. In sum, this article suggests the integration of AI into existing laws, particularly the DMA.

vi.   South Africa's National Climate Change Adaptation Strategy (NCCAS)

The NCCAS provides a comprehensive framework for addressing climate change impacts in the country. The strategy aims to promote climate resilience and adaptation efforts in the national, provincial and local spheres. Although the NCCAS has no specific reference to AI in its plan to aid climate adaptation, the framework suggests strategic Intervention in promoting and investing in research on the most effective adaptation

responses to different climate change impacts. It further recommends establishing programmes to encourage research into new climate change adaptation technologies and innovations supporting climate change adaptation in South Africa. The reference to the word 'climate change adaptation technology' suggests that adoption of AI technologies is supported by the NCCAS.

However, it should be noted that although the NCCAS was developed to offer policy guidelines for the climate change crisis, the strategy itself was not associated with a specific climate change policy, hence the crafting of the national climate change policy, which will be discussed in the ensuing section.

vii.   National Climate Change Response (NCCR) (White Paper)

The NCCR policy delineates South Africa's approach to climate change adaptation. It provides a foundation for South Africa's climate change response, prioritising sustainable development, economic growth and human well-being. Like the NCCAS, the NCCR has no AI-specific strategies nor adequately addresses the potential of AI to aid climate adaptation. The NCCR policy also does not have a clear AI regulatory framework for climate change, let alone for those displaced by the climate change crisis. Nevertheless, it encourages using technology such as EWS to address the climate change crisis. As such, this paper suggests the integration of AI into technological tools such as EWS that can aid climate adaptation. In that light, National, provincial and local governments should integrate AI policies into their climate adaptation strategies. As indicated in the NCCR policy and the NCCAS, funding climate change adaptation technologies and innovations is paramount for effective planning and coordination of an integrated adaptation response

to climate change. According to paragraph 11 of the NCCR policy, the government, in pursuit of a long-term funding framework for climate finance, must;

11.1.4.a Promote fair, transparent and timely access to international and domestic resources for both mitigation and adaptation actions by the public and private sectors as well as civil society.

11.1.4.b Mainstream climate change response into the fiscal budgetary process and so integrate the climate change response programmes at national, provincial and local government and at development finance institutions and state-owned entities.

11.1.4.c Enable the local development finance institutions to create and implement long-term climate-resilient investment programmes. This includes project development, financial and risk insurance products, technical assistance and capacity-building within their mandates.

11.1.4.d Identify opportunities in the existing financial regulations governing the domestic finance sector to enhance the financial sector's capacity to mainstream climate change in risk and investment decisions.

11.1.4.e Establish and/or support public platforms to assimilate and disseminate climate science, finance, technology and other related research and information to enable effective decisions about risk and investment.

11.1.4.f Develop a climate finance strategy that contextualises and integrates existing and emerging policy and financing instruments, including addressing the role of market-based measures to achieve the desired economic and social changes.

In sum, paragraph 11 read with sections 24,26,27 and 29 of the South African constitution and Article 11,12 and 13 of the ICESCR all require that states, in this context, the South African government, to progressively make provisions for the actualization of socio-economic rights of its citizens, including climate change IDPs. This view is further strengthened by international frameworks such as the Kampala convention, UNGP and the ICESCR, that address the plight of climate change IDPs. Section 233 of the South African constitution provides that.

> When interpreting any legislation, every court must prefer any reasonable interpretation of the legislation that is consistent with international law over any alternative interpretation that is inconsistent with international law.

Section 39 of the South African constitution also provides that;

> (1) When interpreting the Bill of Rights, a court, tribunal or forum—
>
> (a) must promote the values that underlie an open and democratic society based
>
> on human dignity, equality and freedom;
>
> (b) must consider international law; and
>
> (c) may consider foreign law.

An overview of the provisions makes it clear and mandatory that courts, tribunals, and forums must consider international laws when interpreting the Bill of Rights. Such interpretations must be consistent with international Law. South Africa already has policies and judicial precedents that bind the government to provide affordable homes for indigent citizens, which has been hitherto complied with. The rights of the IDPs, as

indicated in the international instruments, backed up by National frameworks, are to be respected, protected, fulfilled, and promoted using evolving technology such as AI EWS and tools.

This paper argues that the interpretation of 27 (1)(2) of the DMA and the NCCR policy must be consistent with provisions, principles and guidelines as prescribed in international laws, which proffer that AI technologies be used to mitigate and aid adaptation to climate change in South Africa. It also advocates for the amendment of the NCCR policy to promote innovations and deployment of AI climate technological tools while ensuring safety, fairness, and transparency in their development and deployment. As such, this paper makes the following conclusions and recommendations

5. Conclusion and Recommendations

Climate change poses a significant threat in South Africa, including increased disaster displacement. While IDPs use mobility as a form of coping strategy to escape climate crisis, there is a need to ensure that such mobility does not translate to other forms of maladaptation. AI has the potential to make significant additional contributions to adaptation in the years ahead. Although AI is not the ultimate panacea for climate change, research studies have shown that AI EWS, compared to the conventional EWS, can better predict climate change crises, enabling proactive planning, evacuation and relocation of IDPs. AI could also aid better adaptation regarding humanitarian support and infrastructural design. That said, the integration of AI with other climate technology raises legal and policy considerations because of the dual role of AI as a potential climate adaptation technology and potential threat to the environment. As a result, regulatory

frameworks must be implemented to guide the development and deployment of AI as a climate mobility and adaptation technology. This article recommends using AI for climate mobility and adaptation in South Africa.

1. **The South African government should create an AI task team**.

This group of people will be experts from private and state institutions, academia, and AI experts who will guide AI deployment and regulations. As it stands, the government have a series of forums such as the parliament, the Inter-Ministerial Committee on Climate Change (IMCCC), Civil societies, the Forum of South African Directors-General clusters, the intergovernmental Committee on Climate Change (IGCCC) and the National Disaster Management Council. Any of these groups or cohorts can guide the development of AI climate policies that would regulate the deployment of AIDSHs and EWS, addressing issues surrounding liability and accountability, human rights concerns, and deployment as a climate adaptation tool. The team should be able to define AI terminologies and concepts and set safety and security standards for deploying and using AI. In a cohort with the government, the team should mobilise resources necessary for climate mitigation and adaptation. This may be in financial resources, technical cooperation and technology transfers at domestic, sub-regional, regional, and international levels.

2. Public consultation and engagements

It is paramount that the AI task team engages with civil society, private and public institutions, experts and international institutions to get their input on AI regulations from diverse perspectives.

This paper recommends that SAWs upgrade the existing warning systems and collaborate with other stakeholders to increase the response time for mobility planning and adaptation. Although SAWs have notably disseminated early warning information via radio and television stations, it would be more worthwhile to use SMSs as recommended by ITU.

Finally, this paper further recommends that Section 27 of the DMA and Paragraph 11 of the NCCR policy be read to imply that the South African government shall use or consider the use of AI EWS and AIDSHs to aid mobility and adaptation/ resettlement of IDPs in their new environment rather than in community halls, schools, churches, shacks, squatter camps and other dehumanising environments or housing. As a matter of policy, it would be prudent that resources be set aside for long-term planning for climate mobility and adaptation/resettlement of IDPs as contemplated in the NCCR policy. As promised, the South African government should fulfil its commitment to progressively build the 4 396 temporary accommodations, considering the need to integrate AI tools for better adaptation. The smart-home systems, integrated with other technological systems, such as biogas, can effectively manage human waste, which will be converted to energy for cooking and warmth during winter.

Acknowledgements

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