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# WEATHERING THE STORM IN EUROPE: USE OF AI IN CLIMATE ADAPTATION AND CHALLENGES FOR CLIMATE JUSTICE

## AVRUPA'DA FIRTINAYI ATLATMAK: İKLİM ADAPTASYONUNDA YAPAY ZEKÂ KULLANIMI VE İKLİM ADALETİ İÇİN ZORLUKLAR

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**Anahtar Kelimeler**

*İklim Adaptasyonu,*
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**Özet**

İklim krizi her geçen gün daha da vahim bir hâl almakta ve etkileri artık kırılgan grupları ciddi şekilde etkilemektedir. Bu bağlamda, iklim adaptasyonu ve dirençlilik önlemleri giderek daha fazla Yapay Zekâ (YZ) tabanlı araçların kullanımına yönelmektedir; zira bu teknoloji, çok kısa bir zaman diliminde büyük miktarda veriyi analiz etme imkânı sunarak, aşırı hava olayları, deniz seviyesinin yükselmesi, kuraklık gibi iklim değişikliğinin olumsuz sonuçlarını ve bunların topluluklar üzerindeki etkilerini anlamada umut verici bir araç teşkil etmektedir. Ancak, bu tür araçlar önyargı ve toplumsal riskleri de beraberinde getirmektedir. Bu çalışma, Avrupa'da iklim uyumu kapsamında YZ araçlarının kullanılmasının özellikle iklim değişikliğine karşı direnç geliştirmekte dezavantajlı konumda olan kırılgan gruplar açısından doğurabileceği insan hakları risklerini anlamayı amaçlamaktadır. Bu doğrultuda, uluslararası ve Avrupa düzeyindeki hukuki çerçevelerin söz konusu riskleri ne ölçüde ele aldığını incelemektedir. Bu çerçevede, çalışma, tespit edilen boşluklara yönelik bazı normatif ve politika temelli çözüm önerileri sunmaktadır.

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**Abstract**

The climate crisis is growing increasingly dire by the day, and its impacts are now significantly affecting vulnerable populations. In this context, climate adaptation and resilience measures are inclined to deploy more and more Artificial Intelligence (AI) driven tools as this technology enables analysis of immense amounts of data in a very short time span, which constitutes an auspicious instrument to understand the consequences of climate change such as extreme weather events, drought, rise in sea levels and their impact on communities. However, such tools are not free of bias and social risks. This study aims to understand the human rights risk posed by deploying AI tools in climate adaptation in Europe, particularly for vulnerable groups that are disadvantaged in becoming resilient towards climate change impacts. Accordingly, it examines whether international and European regulatory frameworks effectively address these risks. Given this background, the paper proposes certain normative and policy-based solutions to the identified gaps.



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## I. INTRODUCTION

Today and in the foreseeable future, we face a major challenge due to climate change. The climate crisis is growing more dire by the day. The global efforts aim to keep the global temperature rise below 1.5°C, as per the goal set under the Paris Agreement. However, it is expected that the warming will likely exceed this goal[1]. In this picture, the scientific evidence shows that Europe is warming the fastest among all continents, and the adverse consequences of climate change are clearly here to stay[2]. Constraining the level of warming to beneath a certain level still requires a perpetual and adequate mitigation effort by the public and private decision-makers. Nevertheless, climate action in Europe, which to date was primarily focused on mitigation, now must take the question of how to reduce the harms of climate change and prepare for just resilience in stride. Now, dealing with climate change and its impacts is a tough task; it also further entrenches the social and economic inequalities in society because it unfairly affects the most vulnerable, such as the persons with low income, children, disabled persons or the elderly. The task of achieving social equity and adequacy for climate adaptation in light of the risks of doing too little and too late is critical.

Such challenging tasks will require needs-specific actions and technologies to serve the diverse needs of various vulnerable groups in society. Adaptation is a multifaceted approach that aims to mitigate the damage caused by climate change. Artificial intelligence ("AI") is one such instrument through which climate resilience can be developed. AI can be applied in tackling climate change-induced extreme weather events and natural disasters[3]. It may enhance the adaptation capacity of less developed countries, as well as ensure business continuity by predicting potential disruptions[4]. The use of this new but rapidly growing technology in the context of climate adaptation is still in its infancy. It might be promising, but caution is required for the use of AI because it also has the potential to amplify existing climate vulnerabilities, especially for marginalised communities. The incorporation of an equity lens is hence important as new forms of injustice may emerge.

This study examines, in the first section, the relationship among the concepts of climate justice, human rights and how AI is connected to vulnerabilities for climate adaptation. In the following part, the study explores the potential benefits of AI use for climate adaptation in the EU and investigates whether its application may exacerbate climate injustices. The third part of the study expands on the current state of the law concerning climate justice considerations. It identifies the legal gaps and proposes potential legal and institutional solutions to achieve an inclusive AI-enhanced climate adaptation. Finally, it aims to propose legal and policy solutions that may address to the identified gaps. In doing so, this study only focuses on the AI interaction with climate adaptation measures and excludes the evaluation of the problem concerning AI's energy footprint[5], as this matter exceeds the scope of this paper.

## II. CLIMATE JUSTICE, VULNERABILITY AND ADAPTATION IN THE AI ERA

Climate change is an environmental phenomenon that describes the alteration in the world's climate and weather patterns, as well as a significant shift in social systems. The use of fossil fuels since 1800s has increased greenhouse gas emissions in the atmosphere, and such emissions have started preventing the heat coming from the sun from escaping the world, causing global warming. This temperature rise, causing climate change, shows itself today as sea level rise, drought and more frequent extreme weather conditions. This environmental impact consequently affects fundamental rights, including the right to life, health, physical and mental integrity, respect for cultural heritage and identity, housing, and access to water and food. Therefore, climate change constitutes not only an environmental challenge but a social challenge that may obstruct the safeguarding of certain core human rights[6].

Furthermore, in this constantly warming and altering landscape, certain communities and individuals bear the greatest burdens of the adverse consequences of climate change. They are also in a disadvantaged position because of the existing inequalities in societies, and they have the least capacity to adapt to the changed climate conditions. At this juncture, the concept of climate justice perceives climate change beyond its technical and environmental dimensions, framing a moral and ethical framework, emphasising that both the responsibility of those who caused climate change, and the burden of its adverse consequences are unevenly distributed.[7]

Climate justice as a principle underscores that the communities that have the least responsibility in climate change historically suffer the most from its impacts.[8] However, this concept also has an individual

[1] UN News: "Climate Change: World Likely to Breach 1.5°C Limit in next Five Years", https://news.un.org/en/story/2025/05/1163751, (Accessed: 28.05.2025).

[2] European Environment Agency: "European Climate Risk Assessment EEA Report No 1/2024", https://www.eea.europa.eu/publications/european-climate-risk-assessment, (Accessed: 01.07.2025).

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[4] VAN DEN BERGH, Tim: "How AI Can Help the World Prepare for Climate Adaptation", https://www.weforum.org/agenda/2022/11/how-ai-can-help-the-world-prepare-for-climate-adaptation/, (Accessed: 01.07.2025).

[5] O'DONNELLE, James/CROWNHART, Casey: "We Did the Math on AI's Energy Footprint. Here's the Story You Haven't Heard.", https://www.technologyreview.com/2025/05/20/1116327/ai-energy-usage-climate-footprint-big-tech/, (Accessed: 01.07.2025).

[6] ÇAKAN, Seher: "İklim Değişikliği ve Yaşam Hakkı: Urgenda Vakfı v. Hollanda Hükümeti Davası", Maltepe Üniversitesi Hukuk Fakültesi Dergisi, 2023(1), p. 25-28

[7] LEFSTAD, Lina / PAAVOLA, Jouni: The evolution of climate justice claims in global climate change negotiations under the UNFCCC, Critical Policy Studies, 18(3), 2024, p. 364.

[8] KALLHOFF, Angela: Climate Justice and Collective Action, London/New York, Routledge, 2021, p.18.

aspect which is inherently related to the protection of fundamental rights. Accordingly, individuals who have the least privileged position in a pre-climate crisis era, such as the elderly, children, women, disabled and refugees are disproportionately affected from the climate change in comparison to the other individuals in the same country or region, because they are already marginalized in the given community and lack the adequate resources to adapt to climate change[9].

Climate justice is identified as a framework that is grounded in four dimensions. The first dimension is the recognitional justice, and it acknowledges the specific vulnerable groups, the inherent history of social structures.[10] It focuses on the systemic injustices. In the climate context, the recognitional climate justice underscores how the climate crisis impacts different groups, and it relates to whether the rights of individuals are equally protected. The second dimension is procedural justice, with a main focus on decision-making processes and whether individuals have the opportunity to access climate change information and participate in decision-making effectively.[11] Thirdly, distributive justice aims to frame whether the burden of the consequences of climate change, as well as the resources to face them, are allocated fairly[12]. Finally, intergenerational justice focuses on the protection of the rights of future generations from climate harm[13]. Vulnerability may have different reflections in the context of the climate justice. One reflection of this concept is the need to consider compounded vulnerabilities at the individual level and focus on the most disadvantaged and marginalised groups, which is the central concern elaborated in this study.

There is an evolving adaptation framework that has been developed within the international climate law. There is an emphasis on reduced vulnerability and integration of climate justice concerns in the context of climate adaptation in Article 7 of the Paris Agreement[14]. However, equitable adaptation remains underdeveloped in terms of enforceable legal obligations. Even though international organisations have increasingly started to recognise states' obligations to protect individuals' human rights within the context of climate impacts, the obligation to ensure adaptation has a weak enforcement potential, and the guidance on how to integrate climate justice concerns into adaptation is still limited.

In this context, AI technologies have an important potential to be used as a tool in adaptation and support states to protect vulnerable individuals' fundamental rights that are threatened by climate impacts. There is no doubt that legitimate adaptation is unachievable without an effective human rights protection and being anchored in climate justice. AI tools may indeed provide significant help in recognising vulnerability and effectively allocating resources for disadvantaged groups to become resilient against the climate crisis. However, AI as an enabler may exacerbate existing inequalities in communities, as the data feeding these tools may bring along certain bias towards vulnerable groups and this may threaten certain fundamental human rights.[15] Especially, in the context of climate change adaptation, deployment of AI must be guided by climate justice concerns to move towards a future where fair adaptation may be realised.

## III. USE OF AI TO BUILD A RESILIENT EUROPE

The use of AI is gradually increasing in the efforts targeted for climate adaptation and resilience. It is particularly important to obtain information and predict the impacts of climate change in specific regions. AI is particularly utilised for specific model components to accelerate and reduce costs in technologies that enhance the prediction of climate change impacts[16]. How does the use of AI serve to tackle climate change and reinforce adaptation to it? Machine learning algorithms support climate policymakers by providing more accurate predictions, enabling better preparations, and, where applicable, mitigating certain climate change impacts[17].Therefore, predictive climate and impact modelling indeed provide a good example of the use of AI in terms of climate adaptation. An illustrative example is the AI-driven programs that are used by Conscient AI Labs. These tools are used to understand how sea level rise or extreme weather conditions would impact specific regions and to simulate the potential damage that these impacts may cause[18]. There are also similar tools that are considered as good practice examples for use of AI in adaptation such as World Environment Situation Room tracking atmospheric, sea level and glacier changes, AI for Earth that tracks the impact of climate crisis on livelihood, Met Office monitoring the climate conditions in the United

[9] ÇOLAKOĞLU, Melike: "İklim Adaleti ve Çocuk Hakları", Dicle Üniversitesi Hukuk Fakültesi Dergisi, 28(49), 2023, p. 479-480.
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Kingdom, AI for Social Good, that aims to contribute to food security and FireAId that aims to optimise the resource allocation for wildfires.[19]

Another application of AI for building resilience has seen significant growth in the field of disaster forecasting and alert systems. These deep-learning algorithms are especially beneficial in early warning system development and have strong prospects in preparation for disasters due to climate change[20]. Alan Turing Institute and British Antarctic Survey collaborated to develop Icenet, which is a good illustration of a predictive modelling tool. It is used to understand how sea ice levels change[21]. In the same vein, there is a rise in the use of AI for early warning systems that help prepare against extreme weather events and disasters like floods and wildfires[22].

In this landscape, the EU has rolled out the "Destination Earth" project, which seeks to generate a digital model twin of Earth so that the impact of human-caused climate change can be observed and simulated[23]. In this project as well, the EU Commission determined the intensified use of AI and Machine Learning as a strategic objective[24]. Accordingly, with the integration of new-generation AI models, it is expected that larger weather datasets will be incorporated into the simulations, providing more advanced and accurate predictions[25]. The tools in which large language models (LLMs) are employed may reinforce access to climate information, especially concerning climate information about certain localisations[26]. ClimSight is a good example in this context, as it paves the way for the combination of high-resolution climate data with LLMs[27]. Therefore, it ensures more equitable access to climate change information and facilitates more informed local-level decision-making.

These models may be useful in informing individuals on where to build a sea wall, how to use a certain land, etc. Such tools are also useful in precision agriculture and water management, guiding farmers on crop planting and their interactions with climate change impacts[28]. Another project where AI has been efficiently used to ease collection and analysis is the Mineral Project developed by the X Company, a subsidiary of Google. The Mineral Project is an AI-driven tool that monitors and analyses images of production fields, guiding farmers on how to treat their crops and minimise risks by providing information on soil conditions, weather trends, yield predictions, disease presence, and other potential risks[29]. Similarly, the CENTAUR system has also been effectively integrated into water management systems to provide cheaper and decentralised water management in the UK, Portugal, and France[30].

AI tools for climate are also promising for infrastructure and urban adaptation to climate change[31]. It can, for instance, identify areas prone to disasters and inform decision-makers to take actions, such as constructing sea walls. The AI-driven simulations are helpful in showing how the climate crisis may affect various infrastructure systems and flood vulnerabilities[32]. They analyse satellite thermal and weather information to understand heatwave tendencies and storm surges, and they reinforce pre-emptive action against these impacts [33]. AI for climate adaptation is, after all, a promising innovation which may be utilised to build stronger climate resilience. It enables quicker access to information with more detail. The proponent's views on AI purport that such tools may facilitate the democratisation of access to climate information. In this way, they may empower vulnerable communities, contribute to decision-making and reduce the existing adaptation capability gap, given that vulnerable communities generally lack the required

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[28] KYRIAKOPOULOU, Danae: "What Opportunities and Risks Does AI Present for Climate Action?", https://www.lse.ac.uk/granthaminstitute/explainers/what-opportunities-and-risks-does-ai-present-for-climate-action/, (Accessed: 01.07.2025).
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[33] LIU, p.8.

resources to become climate-resilient [34]. However, AI utilisation for climate adaptation is in its infancy and thus caution is needed because AI use may make things worse while trying to help. It may exacerbate the existing injustices, which the impacts of climate change have already deepened.[35] Hence, a cautious welcome may be advisable for AI use in climate adaptation action, as AI algorithms carry the risk of reflecting the existing biases in a given society and disregarding fair resilience concerns [36]. Deeply rooted vulnerabilities in societies are unlikely to be solved by mere technological fixes. In a context where vulnerabilities need to be carefully considered, the deployment of AI must also be done so, with risks understood and thoroughly analysed.

## IV. CLIMATE JUSTICE CONCERNS AND INTERSECTIONAL VULNERABILITIES IN THE FACE OF AN AI-DRIVEN CLIMATE CHANGE ADAPTATION

The complex character of climate change has begun to be recognised as a "threat multiplier"[37]. Climate change threatens lives as it impacts extreme weather conditions or natural disasters. Climate crisis also adversely impacts the existing inequalities in society, as the disadvantaged, vulnerable groups are forced to carry the burden of the climate change impacts disproportionately[38]. It goes without saying that the implementation of an intersectional perspective in climate adaptation action is imperative to build genuine climate resilience in a given society. One-size-fits-all tools or approaches may not empower marginalised communities. Homogenous treatment of communities may yield unequal and unjust results, and this may exacerbate the existing climate injustices. Therefore, when we welcome the use of AI in the field of climate adaptation, caution should also be endorsed to understand the risks that may be created by such deployment, particularly for the communities that are vulnerable.

Ultimately, the use of AI and access to climate change information depend on users' opportunities and resources. Indeed, the digitalised world and the use of digital systems in almost every aspect of our lives have also deepened certain inequalities and resulted in a disproportionate impact on the "digitally marginalised" communities [39]. Such a digital divide is also an important concern in the context of climate adaptation[40]. Marginalised populations often lack access to an internet connection, smartphone or computers. This can be the case for refugees as they are generally settled in remote areas, and they often lack the required infrastructure to benefit from the technology. Similarly, the older population in society often face challenges in accessing the related digital tools. Moreover, language barriers and a lack of digital literacy, which today constitute a crucial element for AI usage[41], constitute a significant obstacle for such vulnerable groups to benefit from what AI-driven tools may promise. These barriers may deepen the existing inequalities and burden these populations disproportionately on a warming planet[42].

As mentioned previously, AI modelling is increasingly used to gather and analyse data on regional needs, understanding which areas are high-risk or require prioritisation. The socio-economic data concerning marginalised communities are often not sufficient or, in some cases, misrepresented [43] . AI models are based on quantitative data and such data, and the assumptions may cause an AI model to undervalue or neglect certain regions that are considered "low income", or prioritisation of a more cost-effective area may give rise to an inequality, considering the adaptation capacity of vulnerable populations. Biased policies and decision-making are a determinative factor that contributes to the injustices surrounding the implementation of climate policies. An important example, although not from Europe, in this regard is the clearance of favela (slums) communities from Rio de Janeiro, where city authorities took certain measures for the sake of climate resilience but eventually disregarded the social networks, culture and history of favela communities and such urban planning conducted based on climate risk assessments resulted in an unjust removal of a community[44]. Such biases may also be reflected in AI algorithms. After all, AI algorithms are as good as the data they collect and analyse. Although the favela community example is outside of Europe, similar situations may emerge in Europe, and an AI algorithm may perpetuate a long-standing injustice, using its input and analysis

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to justify unfair treatment. Data biases may cause AI to overlook certain vulnerable populations and their intersectionality, potentially directing resources away from those who need them the most.

The use of AI in the context of climate adaptation has the potential to perpetuate epistemic injustice, excluding certain communities' knowledge from this field. Such sophisticated systems generally use technical and scientific knowledge, and indigenous and traditional knowledge may be excluded[45]. Such local, traditional, and indigenous knowledge may be particularly important given these communities' close interaction with nature, and their needs must be taken into consideration when developing adaptation plans and strategies[46]. Therefore, human oversight becomes even more crucial in this context to ensure that all relevant ecological knowledge and experience are incorporated into the AI-driven adaptation systems. AI-for-climate solutions should not treat vulnerable groups as mere passive subjects; instead, their knowledge should be given a scope. Otherwise, the solutions offered by AI tools would not work on the ground and would not empower vulnerable populations.

Another risk that the use of AI may exacerbate, concerning potential inequality, is the climate-smart agriculture practice. Small-scale farmers are another vulnerable group that carries a disproportionate burden of the negative effects of climate crisis[47]. In agri-tech solutions, small-scale farmers also face a disadvantaged position compared to wealthy agribusinesses. Low-income farmers often lack the required resources or digital literacy to adapt to and utilise the necessary sensors and platforms for collecting data on farming practices or crops. In case the climate adaptation of the agricultural industry becomes dependent on AI-driven technology, small-scale farmers may face the risk of being left behind, losing support, and exacerbating rural inequality[48]. To ensure a just climate adaptation, decisions on adaptation measures must be based on pluralism, and every voice should be represented in this decision-making process. Overreliance on AI-driven decision-making may create a risk for vulnerable groups who have already faced disadvantages in exercising their participatory rights, undermining their voice and rendering them mere subjects exposed to adaptation policies.

Overall, AI for climate is indeed promising in ensuring faster and less expensive climate adaptation. However, it should not be forgotten that it is not without risks, and its reliability is contingent upon the accuracy and completeness of the quantitative data provided for analysis. Biases in each society may be reflected in the functioning of the AI. Deliberate safeguards are necessary to prevent the exacerbation or replication of existing patterns of inequality in societies. The scenarios mentioned above are not merely theoretical; they may have concrete legal consequences and lead to human rights violations. To address these risks, it is important to explore whether existing legal frameworks have the safeguards ensuring that the promising features of AI would not make things worse while trying to help.

## V. LEGAL FRAMEWORKS TO ADDRESS AI FOR CLIMATE-RELATED VULNERABILITY EXACERBATION

An important question to ask in a world where climate adaptations have started to be facilitated by AI-driven tools is whether the existing legal frameworks provide sufficient checks and balances on this new technology to ensure that they do not discriminate and violate fundamental human rights. As this study aims to evaluate the AI-driven climate adaptation's implications on human rights in Europe, this section expands on the applicable legal framework in Europe and aims to explore to what extent the current legal landscape addresses the risks of AI-for-climate tools on the rights of vulnerable communities. Accordingly, this section first elaborates on the existing applicable human rights framework. It then examines the climate-related instruments, and finally, it looks into the European framework, with a particular focus on the EU Artificial Intelligence Act (AI Act).

### A. Instrumentalization of Human Rights Frameworks

Climate adaptation and the measures taken in this regard are intrinsically linked to certain fundamental rights that are safeguarded under international and European human rights protection regimes. When extreme heat waves occur, they threaten individuals' health. The drought due to climate change constitutes a barrier for individuals to access water and food resources. These impacts necessitate the adoption of specific measures and assurance of the required early warning technology and infrastructure. Moreover, the adverse consequences of climate change impact agriculture, endanger food security and prevent individuals from accessing adequate food or safe areas due to sea-level rise, forcing people to relocate to safer, habitable areas.

In this context, climate adaptation should not be seen as a merely technical response to an environmental problem. It is, in fact, a sine qua non for the implementation of certain fundamental human rights that underpin human dignity. It has also been argued that a right to climate adaptation exists to ensure that existing human rights are safeguarded[49]. However, currently, under the existing legal frameworks, there

[45] OFOSU-ASARE, Yaw: "Cognitive Imperialism in Artificial Intelligence: Counteracting Bias with Indigenous Epistemologies", AI & Society, 40(4), 2025, p. 3046.
[46] OFOSU-ASARE, p. 3048.
[47] International Fund for Agricultural Development: "Small Farms, Big Impacts: Mainstreaming Climate Change for Resilience and Food Security | FAO", https://www.fao.org/family-farming/detail/en/c/409382/, (Accessed: 01.07.2025); DOĞRU, Barış/GÖKALP ALICA, Süheyla Suzan: İklim Mücadelesinde Ekonomik, Sosyal ve Ekolojik Adalet, İklim Değişikliği Eğitim Modülleri Serisi 16, 2019, https://www.iklimin.org/wp-content/uploads/egitimler/seri 16.pdf, (Accessed: 01.07.2025).
[48] MALIK, S. Ali: "Linking Climate-Smart Agriculture to Farming as a Service: Mapping an Emergent Paradigm of Datafied Dispossession in India", The Journal of Peasant Studies, 50(6), 2023, p. 2191- 2195.
[49] BORDNER, Autumn/BARNETT, Jon/WATERS, Elissa: "The Human Right to Climate Adaptation", npj Climate Action, 2(1),

is no explicit recognition of a right to climate adaptation, let alone explicit protective provisions to ensure an indiscriminate deployment of AI in adaptation processes. That said, the current international legal framework on human rights has the potential to be strategically used for the claims when the use of AI threatens the fair implementation of climate adaptation measures.

Given the primordial importance of adaptation measures, the right to climate adaptation is an integral part of certain human rights that are safeguarded under various international human rights instruments. Accordingly, the International Covenant on Civil and Political Rights (ICCPR), one of the first binding international human rights instruments, is relevant in this context, as it explicitly safeguards the right to life under Article 6. As per Article 26 of the ICCPR, such a right is to be protected indiscriminately, as it stipulates that "all persons are equal before the law and are entitled without any discrimination to the equal protection of the law. In this respect, the law shall prohibit any discrimination and guarantee to all persons equal and effective protection against discrimination on any ground such as race, colour, sex, language, religion, political or other opinion, national or social origin, property, birth or other status"[50]. Climate adaptation measures are primarily used to save one's life. These measures are to be made available without any discrimination. It is a State's positive obligation to ensure that the climate adaptation measures are implemented inclusively. Accordingly, it is possible to argue that if an AI-driven tool neglects the adaptation needs of members of disadvantaged communities, Articles 6 and 26 of the ICCPR may provide the legal basis for a claim to benefit from climate adaptation processes.

It is also important to note that climate adaptation is highly relevant to an individual's right to live in a healthy and sustainable environment. The ICCPR does not explicitly incorporate a right to a healthy environment. However, the right to a clean, healthy, and sustainable environment has recently been recognised by the United Nations General Assembly (UNGA) as a human right[51]. UNGA emphasised that "while the human rights implications of environmental damage are felt by individuals and communities around the world, the consequences are felt most acutely by women and girls and those segments of the population that are already in vulnerable situations, including indigenous peoples, children, older persons and persons with disabilities"[52]. Thus, a claim for fair adaptation rights may take its legal support from the existence of a fundamental right to live in a healthy and sustainable environment.

In this context, the European Convention on Human Rights (ECHR) is a key regional human rights law mechanism, the implementation of which is overseen by the European Court of Human Rights (ECtHR or the Court).[53] The ECHR does not have a specific article safeguarding a right to a healthy environment, let alone a right to climate adaptation. Be that as it may, this did not preclude the ECtHR from deciding on matters concerning climate change. In its recent landmark Verein KlimaSeniorinnen ruling, the Court applied Articles 2 (right to life) and 8 (right to private and family life) to a case, observing that the avoidance of fulfilling states' obligations to take concrete measures against climate change impacts constitutes a violation of the ECHR[54]. In its ruling, the Court acknowledged that governments have a positive obligation to consider the measures and actions to be implemented to protect individuals' rights.[55] The decision may also be interpreted as meaning that, in case the required measures and actions are not taken by the State, to ensure climate adaptation, the duty of states to implement effective climate action will not be fulfilled within the framework of the ECHR. Therefore, ensuring equitable adaptation is part of the State's positive obligations in terms of Article 2, Article 8, as well as Article 14 (prohibiting any discrimination in the implementation of the ECHR rights) of the ECHR. If AI-informed adaptation decisions result in the exclusion of certain vulnerable groups, lead to forced displacement, or cause avoidable injuries or deaths, this may indeed constitute a violation of the Articles above. Depending on the specific circumstances, Article 1 of Protocol No. 1, the provision that safeguards the right to property, may also have a scope of application, especially if the measures at hand involve urban planning or disaster management that addresses property risks.

However, relying on the ECHR to address such injustices may have certain limitations, especially in terms of showcasing the victim's status. The Verein KlimaSeniorinnen case was a success for a legal person; an association representing elderly women was one of the parties in the case, whereas the individual elderly women's victim status was not accepted, and the case was deemed inadmissible for them, as the ECtHR applies a high and strict threshold in terms of victim criteria. Given this aspect, even though ECHR frameworks provide a legal basis for potential rights violations affecting vulnerable groups in the context of climate adaptation, not every individual may benefit from the protection afforded by the Convention. It is also important to emphasise that the ECHR provides a retrospective protection. Cases are generally brought

2023, p.1–4.

[50] OHCHR: "International Covenant on Civil and Political Rights", https://www.ohchr.org/en/instruments-mechanisms/instruments/international-covenant-civil-and-political-rights, (Accessed: 01.07.2025).

[51] United Nations General Assembly: "Promotion and Protection of Human Rights: Human Rights Questions, Including Alternative Approaches for Improving the Effective Enjoyment of Human Rights and Fundamental Freedoms", https://digitallibrary.un.org/record/3982508, (Accessed: 01.07.2025).

[52] United Nations General Assembly: "Promotion and Protection of Human Rights: Human Rights Questions, Including Alternative Approaches for Improving the Effective Enjoyment of Human Rights and Fundamental Freedoms", https://digitallibrary.un.org/record/3982508, (Accessed: 01.07.2025).

[53] For more on climate jurisprudence of the ECtHR see AÇIKGÜL, Hacı Ali: "İklim Değişikliğinden Kaynaklı İnsan Hakları İhlalleri Nedeniyle Devletin Yargılama Yetkisine İlişkin Uluslararası İnsan Hakları Organlarınca Verilen", Adalet Dergisi, 74, 2025, p. 258-264.

[54] ECtHR, Verein KlimaSeniorinnen Schweiz and Others v. Switzerland, Application No. 53600/20, 09.04.2024.

[55] ÇAKAN, Seher: "Avrupa İnsan Hakları Mahkemesi'nde İklim Değişikliği Davaları", Ankara Hacı Bayram Veli Üniversitesi Hukuk Fakültesi Dergisi, 29(1), 2025, p. 233.

before the courts when a violation has already occurred and a specific harm has resulted. Hence, such a legal framework would not be particularly helpful in preventing such harm. Lastly, as climate adaptation strategies and planning are generally a result of complex technical decision-making (informed by AI-driven risk assessments or not), the ECtHR may be reluctant to interfere in such decision-making, especially in terms of the use of AI and may likely grant a margin of appreciation to the state.

Another important aspect of human rights that may be affected by AI-driven climate adaptation is procedural environmental rights, which are not explicitly embedded in the ECHR framework. In this context, the more relevant specific instrument would be the Aarhus Convention, under which the rights to "environmental information, participatory rights in environmental decision-making, and access to justice" are safeguarded[56]. As per the Aarhus Convention, an adaptation plan applied in a specific region to involve stakeholder participation should include public consultation, and vulnerable groups must be represented in this project[57]. Even without the deployment of AI, marginalised communities often face barriers to exercising these rights. Therefore, if AI-for-climate tools are to be deployed in climate adaptation planning, specific attention should be paid to ensure that the AI-driven decision-making process is also Aarhus compliant and environmental procedural rights are not violated.

### B. Instrumentalization of Climate Law Instruments

Another important and relevant framework that may be applicable in terms of AI-supported climate adaptation is the United Nations Framework Convention on Climate Change (UNFCCC), as well as the Paris Agreement adopted by the United Nations Climate Change Conference.

The preamble of the Paris Agreement stipulates that all parties are to "respect, promote and consider their respective obligations on human rights" when they implement climate action[58]. It also lists the vulnerable groups and their rights, such as "the right to health, the rights of indigenous peoples, local communities, migrants, children, persons with disabilities and people in vulnerable situations and the right to development as well as gender equality, empowerment of women and intergenerational equity"[59]. Moreover, Article 7.5. of the Paris Agreement stipulated that "the adaptation action should follow a country-driven, gender-responsive, participatory and fully transparent approach taking into consideration vulnerable groups, communities and ecosystems and should be based on and guided by the best available science and as appropriate traditional knowledge of indigenous peoples and local knowledge systems with a view to integrating adaptation into relevant socioeconomic and environmental policies and actions, where appropriate." The Paris Agreement provides a general framework guiding the structure of adaptation efforts. The inclusiveness of vulnerable communities is encouraged[60]. For this reason, it is possible to argue that all parties to the Paris Agreement have a positive obligation to ensure that vulnerable communities' needs are taken into account and climate justice concerns are given scope in climate adaptation, even in situations where AI tools enhance adaptation actions. These provisions surely provide a guiding principle for the use of AI in climate adaptation.

AI-driven tools are products that are created by private persons, and mostly corporations. Considering this aspect, the UN Guiding Principles on Business and Human Rights may also be treated as an important source that can guide how corporations should functionalise AI tools. The Guiding Principles do not have a specific provision concerning corporations' specific obligations to ensure a just climate adaptation for vulnerable populations; however, they accrue a certain due diligence responsibility to business enterprises to respect human rights, and therefore, they should avoid infringing on human rights when operating[61]. Accordingly, it is possible to argue that a private corporation developing an AI-driven tool to be utilised within the field of climate adaptation has an obligation of due diligence to identify whether the tool in question constitutes any risk in terms of human rights interference and in this context, the protection of vulnerable populations should be an important consideration. If a technology company supplies an AI tool for disaster response, such a tool must be designed to address the needs of vulnerable communities. It may be argued that States are required to ensure that relevant regulations are in place to ensure business conduct is fair, climate adaptation compliant, and fairness checks are fulfilled. Certain companies incorporate such fairness checks voluntarily. However, the protection of vulnerable populations in the context of climate adaptation should not be based solely on voluntarism, and certain oversight is required to prevent discriminatory practices.

### C. EU Law and Policy: Fundamental Rights and AI Governance

There are also crucial legal instruments that may be applicable for AI use in climate adaptation in European law. Moreover, the EU Climate Governance and the guidelines prepared within this framework are also relevant in terms of understanding the importance of the protection of vulnerable groups. First of all, the Treaty on the Functioning of the European Union provides the fundamental background for ensuring Member States ' obligations to protect the environment. Accordingly, Article 11 requires environmental

[56] UNECE: "Convention on Access to Information, Public Participation in Decision Making and Access to Justice in Environmental Matters", https://unece.org/environment-policy/public-participation/aarhus-convention/text, (Accessed: 01.07.2025).
[57] NÓBREGA, Sandra: EU Climate Law through the Lens of the Aarhus Convention: Access to Environmental Information and Public Participation in EU Climate Change Decision Making, Maastricht: ProefschriftMaken, 2020, p. 55.
[58] United Nations: "Paris Agreement", https://unfccc.int/process-and-meetings/the-paris-agreement, (Accessed: 01.07.2025).
[59] United Nations: "Paris Agreement", https://unfccc.int/process-and-meetings/the-paris-agreement, (Accessed: 01.07.2025).
[60] LESNIKOWSKI, Alexandra et al.: "What Does the Paris Agreement Mean for Adaptation?", Climate Policy, 17(7), 2017, p. 826.
[61] MACCHI, Chiara: "The Climate Change Dimension of Business and Human Rights: The Gradual Consolidation of a Concept of 'Climate Due Diligence'", Business and Human Rights Journal, 6(1), 2021, p. 109.

protection's integration in policies and activities of the EU specifically when it comes to promoting sustainable development. In a similar vein, Article 191 requires EU policy to contribute to protecting the environment and human health, as well as promoting measures to combat climate change. In other words, protection of the environment and combat against the climate crisis constitute a core concern in EU policies. One may ask whether there is an enforceable right to fair adaptation to climate change in the EU legislation, and there is a sufficient framework to address AI concerns in the case of the use of such tools in climate adaptation.

The EU Charter of Fundamental Rights ("Charter") constitutes one of the most important human rights protection mechanisms within the EU, together with the ECHR elaborated above. The Charter is binding for EU institutions and Member States, and it provides specific protection for the rights of children, the elderly, as well as persons with disabilities under Articles 24, 25 and 27, respectively. The Charter also includes provisions concerning the rights to equality and non-discrimination as per Article 21, as well as the principle of environmental protection and sustainable development under Article 37. Accordingly, the operation of the EU Institutions must comply with the Charter. Thus, in case an AI-driven adaptation tool is used in a European Commission initiative, its operation should comply with all the above-mentioned provisions and should not yield to any indiscriminative practices. However, it is also important to note that such high-level norm application to specific initiative projects is rare.

The EU has a leading position in terms of the implementation of the measures that aim to realise the Paris Agreement climate goals. For this, the EU has a thorough legal and policy framework for climate change, especially as per the EU Climate Law and the Green Deal. The EU has not adopted any binding document specifically focusing on fair climate adaptation. However, the EU has an adaptation strategy, and socially just resilience is an important consideration in this strategy. It provides a policy framework and guidelines on the values to be incorporated into climate adaptation actions[62].

The climate policy and governance in the EU gained legal teeth with the European Climate Law, which imposed obligations on EU Member States to achieve climate neutrality goals, as well as obligations regarding progress on climate adaptation. Adaptation is considered as a "key component" of climate action in the European Climate Law.[63] Article 5 of the European Climate Law guides member states on their obligations considering adaptation and strengthening resilience. Accordingly, Member States, while employing "coherent" and "mutually supportive" adaptation policies, are required to develop national adaptation strategies and conduct regular risk assessments to address the impacts of climate change. Moreover, Article 5 also requires Member States to "focus in particular on the most vulnerable and impacted populations and sectors and identify shortcomings in this regard on consultation with civil society". Moreover, pursuant to Article 9, a climate-resilient society should be empowered by enabling inclusive and accessible public participation processes.

Given this legal background, combined with the European Green Deal, the rhetoric "just resilience" is one of the central concepts in the EU Adaptation governance that aims to accomplish an inclusive and fair climate adaptation. Although there is no binding instrument specifically targeting climate adaptation, the EU Adaptation Strategy also prioritises ensuring a socially just, climate-resilient society. It emphasises that all Member States should take measures to achieve this transformation.

Most recently, the European Climate Risk Assessment ("EUCRA") has called for timely targeted actions to address the unique challenges that marginalised communities encounter. Similarly, the Communication on Managing Climate Risks – Protecting People and Prosperity advocates for a "whole-of-society" approach to building climate resilience, and it emphasises the importance of involving vulnerable groups in the policymaking process[64]. Both of these recent documents go beyond technical measures. They promote an inclusiveness-centred approach and highlight the importance of protecting the well-being and rights of vulnerable populations to ensure a climate-resilient future if the EU is to adopt a "no one left behind" policy[65]. Although there is a certain emphasis on the importance of inclusiveness in climate adaptation in the EU's climate adaptation guidelines, the potential of AI to exacerbate vulnerability in European society, as well as the risks associated with algorithmic bias and the inclusive use of AI, are not among the addressed concerns.

Considering the deployment of AI within the context of climate adaptation, one of the most important EU legislations to consider is undoubtedly the AI Act. The AI Act's objective is to ensure deployment and development of AI systems in a way that these systems shall respect fundamental rights, health and safety[66].

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[62] European Commission: "EU Adaptation Strategy", https://climate.ec.europa.eu/eu-action/adaptation-climate-change/eu-adaptation-strategy en, (Accessed: 01.07.2025).

[63] European Parliament and Council: Regulation (EU) 2021/1119 of 30 June 2021 ('European Climate Law') establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999, Official Journal of the European Union, L 243, 9 July 2021, pp. 1–17, https://eur-lex.europa.eu/eli/reg/2021/1119/oj, (Accessed: 01.07.2025)

[64] European Commission: "Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Managing Climate Risks (COM/2024/91 final)", https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52024DC0091, (Accessed: 01.07.2025).

[65] MOTTLEY, Mia et al.: "A Green Transition That Leaves No One Behind", https://ec.europa.eu/commission/presscorner/detail/en/ac 23 3426, (Accessed: 01.07.2025).

[66] The European Parliament And Of The Council: "Regulation (EU) 2024/1689 of the European Parliament and of the Council of 13 June 2024 laying down harmonised rules on artificial intelligence and amending Regulations (EC) No 300/2008, (EU) No 167/2013, (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1139 and (EU) 2019/2144 and Directives 2014/90/EU, (EU) 2016/797 and (EU) 2020/1828 (Artificial Intelligence Act)", https://eur-lex.europa.eu/eli/reg/2024/1689/oj/eng, (Accessed: 01.07.2025).

Accordingly, the AI Act's classification is based on risks, and certain AI applications are categorised as high-risk applications. The AI Act aims to minimise concerns arising from the use of AI, such as bias, safety failures, and a lack of transparency. Nevertheless, upon closer examination of the AI Act from the perspective of climate adaptation justice, certain gaps can be identified. Indeed, neither climate adaptation nor environmental management AI are classified separately as a high-risk category. High-risk AI includes areas such as infrastructure, emergency services, public safety and access to essential services. The EU AI Act deems AI systems high-risk either when they are safety components of products that fall under third-party conformity assessment or when they are part of specific sensitive use cases in Annex III[67]. The latter includes systems used in biometric identification, critical infrastructure, education, employment, access to essential services (including healthcare, credit, and emergency response), law enforcement, migration and asylum procedures, administration of justice, and democratic processes[68]. High-risk AI systems are subject to stringent requirements as they have the potential to significantly impact fundamental rights, safety, and the well-being of citizens in these zones[69].

Indeed, certain climate adaptation practices may be treated under the classification of high-risk AI. The use of AI-driven disaster management or early warning systems may be classified as high-risk AI. In these cases, risk assessments, quality data, transparency and human oversight are required for these systems. Such requirements may decrease the risk of bias or exclusion of vulnerable communities in the use of AI-driven systems. For example, suppose an AI-driven wildfire warning system is considered high risk. In that case, providers of such a system are required to ensure that it is reliable across different populations, regardless of their marginalisation in society. However, climate justice or equitable outcomes are not explicitly embedded in the AI Act, despite the Act's explicit mention of the use of AI in climate adaptation in its justification. During the legislative discussion of the Act, experts also pointed out that "climate change mitigation and adaptation should join other factors in informing whether an AI system is classified as high risk"[70].

There is significant criticism of overlooking the carbon footprint of the AI systems and the fact that environmental sustainability is given scope as a mere ethical principle[71]. However, the Act does not explicitly require AI deployment to be aligned with the EU's climate goals and adopt an intersectional perspective on protecting vulnerable groups. Therefore, there is no specific requirement for AI-driven climate adaptation tools or systems to undergo an environmental and human rights impact assessment, with particular consideration of climate injustices. Overall, fair and inclusive adaptation appears to be an emerging concern area that is increasingly being voiced in the EU climate agenda. Yet, the current legal framework at the international and EU levels constitutes merely certain pieces of a puzzle, and it is far from constituting the full picture. The current international and regional human rights protection instruments indeed provide a feasible starting point to infer that states must ensure just adaptation for everyone equally, without discrimination, and address the specific needs of the vulnerable communities. Still, a particular normative framework on the equitable and inclusive use of AI within the context of climate adaptation may provide more efficient adaptation governance, as these tools are expected to be widely used in this area. Moreover, the rules stipulated within the context of the climate law, from the Paris Agreement to EU instruments, indeed recognise climate justice concerns as a crucial consideration. Yet, they are still short of offering concrete mechanisms to fully address the specific adaptation needs of the community, thereby falling short of solutions to address the problems that may arise due to AI-enhanced climate adaptation. Finally, although the legal instruments for AI governance in the EU have a specific focus on the safe use of AI that respects human rights, climate justice concerns do not currently constitute a priority area despite the immense potential for AI use in climate governance. Overall, all three legal regimes leave an AI vulnerability gap that may result in unequal adaptation and exacerbate existing inequalities in climate adaptation.

## VI. TOWARDS A MORE INCLUSIVE CLIMATE ADAPTATION THROUGH AI

A more considerate approach is needed, given that the climate crisis is a rapidly evolving and complex problem, and the use of AI is proliferating in an unprecedented manner. The potential problems discussed in this study may become a concrete legal question sooner than expected. It is essential to ensure that AI deployment in climate adaptation empowers vulnerable communities and does not exacerbate existing inequalities.

At this juncture, one may ask about concrete examples of the potential discriminative practices that may be exacerbated by the use of AI within the context of climate adaptation. Such impact may be visible in Europe, particularly for the vulnerable, marginalised groups such as the Roma communities that often live in unregistered settlements, which may be prone to floods. Such informal settings may be excluded from the official data that are used by the municipalities to be analysed by AI-based flood risk mapping tools, and this may result in overlooking the needs of such communities in climate adaptation planning, and it can worsen

[67] Artificial Intelligence Act, Article 6 (1)-(2).
[68] Artificial Intelligence Act, Annex III.
[69] KUSCHE, Isabel: "Possible Harms of Artificial Intelligence and the EU AI Act: Fundamental Rights and Risk", Journal of Risk Research, 2024, p. 8. See also BAŞARA, Gamze Turan: "Avrupa Dijital Düzenleme Sisteminde Yapay Zekâ Yasası", Ankara Üniversitesi Hukuk Fakültesi Dergisi, 73(4), 2025, p.3004-3007,
[70] KLEMMER, Konstantin/KAACK, Lynn H./DUNIETZ, Jesse: "CCAI's Comments on the EU's Proposed Harmonized Rules on AI", https://www.climatechange.ai/blog/2021-11-02-eu-regulation, (Accessed: 01.07.2025).
[71] HILLE, Hauke: "The EU's AI Act: Dangerously Neglecting Environmental Risks", https://sustain.algorithmwatch.org/en/the-eus-ai-act-dangerously-neglecting-environmental-risks/, (Accessed: 01.07.2025).

their exposure to climate impacts. Similarly, AI may be deployed in post-disaster support systems. Eventually, these systems would take into account the information on well-documented property, and such deployment may exclude, for instance, undocumented migrants, excluding them from the required insurance access, the disaster aid responses as well as the relocation plans[72].

Given this pressing need, firstly, incorporating climate justice concerns into AI governance and requiring a climate justice impact assessment for high-risk AI systems may better address the justice concerns. This can be achieved by providing guidelines for the responsible use of AI in climate adaptation, ensuring that vulnerable groups are equally protected and safeguarded. Indeed, impact assessment requirements may enhance these efforts to ensure justice in adaptation by enabling developers to test whether the system at hand has varying error rates or poses accessibility gaps among marginalised populations.

It is essential to emphasise that the AI Act's implementation in the context of climate adaptation justice may not be straightforward and requires an in-depth interaction with climate and human rights experts whenever an AI tool is used or planned for use in the context of climate adaptation. Ultimately, the potential impact and risk of AI use should be treated with caution, as with other high-risk categories of AI use.

As mentioned above, the potential use of AI in decision-making should not result in the exclusion of the voices of marginalised groups. Special oversight is required to ensure that the public participation requirements are strictly implemented and that consultation with affected communities, including the participation of vulnerable groups, is conducted before proceeding with an adaptation measure. A strengthened public participation requirement, whenever an AI-driven adaptation measure is implemented in a decision-making process, may ensure that inclusiveness is not undermined. As emphasised in Article 9 of the European Climate Law, actions to ensure a climate-resilient society must be anchored in an "inclusive and accessible process at all levels". Special caution on public participation requirements especially concerning AI driven measures may be considered a reflection of this obligation. Such an approach would also be aligned with the Aarhus Convention obligations and safeguard a participatory adaptation. For instance, if AI is to be deployed in city planning for adaptive drainage projects, all residents of the affected area should have a say in the decision-making process. The process should be made transparent to show all affected individuals how AI is used to provide an opportunity to test whether there is no discriminatory bias influencing the decision-making.

AI tools are mostly developed by private tech companies. Accordingly, these companies' due diligence obligations come to the forefront to ensure that they do not violate human rights through the AI solutions they provide. Climate AI solutions are not excluded from this concern. Companies must provide these tools with warranties to prevent any exclusions from taking effect. To ensure such operation, contract law solutions may be functionalised, especially concerning the procurement process. In this context, the UN Guiding Principles on Business and Human Rights may set a direction. Procurement contracts may be designed to include non-discrimination or transparency clauses to ensure that there is no such violation in the development of a given AI tool, as well as during its implementation and in its outcomes. Additionally, they can mandate certain community training components to ensure accessibility. In fact, the Corporate Sustainability Due Diligence Directive ("Due Diligence Directive"), which recently entered into force in July 2024, provides a favourable instrument for supervising AI-driven climate adaptation processes[73].

The Due Diligence Directive requires all Member States of the EU to "ensure that companies conduct risk-based human rights and environmental due diligence"[74]. Complying with their obligations under this directive, States may require AI developer tech companies to perform their due diligence obligations with vulnerability components. Accordingly, the Directive also requires the Member States to ensure that companies have a functional complaint procedure to assess individual complaints that aim to address "concerns regarding actual or potential adverse impacts with respect to the companies' […] operations.". Such mechanisms may enable States and tech companies to ensure that the rights of all vulnerable groups are sufficiently addressed whenever AI drives adaptation processes.

Empowering vulnerable communities against climate and technology risks is a topic that cannot be solved merely by legal solutions; an institutional shift is required to achieve the "Leave No One Behind" promise. Capacity building of the communities, with community science initiatives where local communities may engage with AI climate solution designing to make sure that they address their needs better. Accordingly, initiatives that enable participatory risk mapping may be important for communities to have their say in adaptation processes. There are indeed certain examples of pilot projects that already embody these practices, such as the participatory flood risk mapping initiatives conducted by the ETH Zurich research group in Congo[75]. Such approaches may be scaled and formalised in the EU concerning AI-driven adaptation projects, and the participation of vulnerable communities in these tools and their implementation may be ensured.

[72] For ethical risks in AI deployment in the context of climate crisis see more in HAN, Chao/ZANG, Shan: "A Comprehensive Review of Disruptive Technologies in Disaster Risk Management of Smart Cities", Climate Risk Management, 48, 2025, p. 11-12.

[73] The European Parliament and The European Council: "Directive (EU) 2024/1760 of the European Parliament and of the Council of 13 June 2024 on Corporate Sustainability Due Diligence and Amending Directive (EU) 2019/1937 and Regulation (EU) 2023/2859 (Due Diligence Directive)", https://eur-lex.europa.eu/eli/dir/2024/1760/oj/eng, (Accessed: 01.07.2025).

[74] Due Diligence Directive, Article 5.

[75] ETH ZURICH: "Piloting the Flood Risk Mitigation Toolbox for Refugee Settlements", https://un-eth.ethz.ch/impact/news-channel/2024/11/piloting-the-flood-risk-mitigation-toolbox-for-refugee-settlements.html, (Accessed: 01.07.2025).

In the longer term, setting global norms on Just Adaptation standards may push States to incorporate more specific provisions and measures concerning AI's impact on Climate Adaptation Rights. The EU already holds a leading position in the UNFCCC for implementing climate mitigation and adaptation obligations, and it can leverage this position to champion these issues and ensure that just AI for climate adaptation is accessible with sufficient funding in developing countries.

Overall, technology does not merely have a practical aspect, but it is also a means of empowerment for the more disadvantaged groups. AI may indeed assist these groups in many aspects to survive and thrive amid climate change. However, a favourable legal framework, guidance, reliable monitoring mechanisms, and community participation are key to ensuring that adaptation occurs in compliance with the values of justice.

## VII. CONCLUSION

The use of AI in the context of climate change adaptation is a double-edged sword. AI has a promising capability to increase individuals' adaptation capacity in the face of the adverse impacts of climate change. The AI tools are capable of using large amounts of data and producing outcomes in a short period of time. In this way, it optimises the use of resources, informs people on the potential timing of weather events, can assist urban planning or provide useful data analysis for decision making. Therefore, within the context of climate adaptation, AI has a genuine potential to foster resilience and save lives.

However, all roses have their thorns, and the implementation of AI for climate adaptation is not without risks. The bias concerns for AI applications are also applicable to the climate adaptation context. AI may perpetuate systemic biases. Such a situation may deepen the existing societal injustices, and the climate impact burden on vulnerable groups may get even heavier. For this reason, continuous monitoring of the AI design and implementation during climate adaptation processes is crucial to prevent the widening of the justice gap in climate resilience.

There is no specific European or international binding climate adaptation instrument under the current legal frameworks that Europe can directly refer to. Climate action must safeguard human rights, and vulnerable populations should receive special consideration. Translating this principle into the implementation of AI-driven adaptation, however, constitutes a challenge, as it remains ambiguous from a legal perspective on how these two emerging regimes intersect. Therefore, the question of how to regulate AI to ensure that vulnerable communities are not overlooked will require significant attention from both political and legal authorities. This study has explored the potential of the current legal frameworks and attempted to understand whether they provide a sufficient design to realise the "Leave No One Behind" promise. Although these provide an important normative framework that may address the justice concerns that may arise from AI-driven climate adaptation, a more effective approach requires more innovation.

Adaptation is a complex problem for which piecemeal solutions will not suffice. Practically, legal frameworks should be enhanced to recognise the high human rights risks that AI use poses in the climate adaptation process. These frameworks should address both the responsibilities of states and AI development companies in respecting the fundamental rights of vulnerable communities. Regulatory oversight mechanisms may be functionalised to proactively address the impacts of AI on disadvantaged groups in the context of climate adaptation. It is crucial to have legal standards, a robust monitoring mechanism and an institutional approach for the development phase of the AI-driven adaptation tools. This will involve cooperation among climate and data scientists, AI engineers, community leaders and legal experts. Overall, a just climate adaptation is a matter of survival. Only an integrated approach may enable the EU to realise the promise of climate resilience that leaves no one behind.

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