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Harnessing AI for Climate Change Mitigation: Strategies Challenges and Opportunities

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ABSTRACT

Artificial Intelligence (AI) is becoming a new game-changer in the process of climate change mitigation worldwide, and it presents novel opportunities to optimize renewable energy production, assess and monitor emissions, and manage sustainable resources. This paper is based on a qualitative and integrative literature review design where the researchers look at appropriate published studies, industry reports, and policy documents in order to evaluate current applications, issues, and trends, as well as prospects of AI. The findings indicate that AI-based weather forecasting models make solar and wind energy generation more accurate, the predictive maintenance saves more time on using renewable infrastructures, and optimization algorithms optimize the industrial process, cutting the greenhouse gases (GHG) emissions. Computer vision and remote sensing using AI promote near-real-time identification of methane leaks, industrial releases, and clearing of

forests to increase intervention time. Nevertheless, its prospects are limited by obstacles, including heavy energy consumption, data sparsity, biased algorithms, and a lack of either official regulation or oversight. The promising areas of AI involving IoT and blockchain, low-carbon algorithms of AI, and equitable access to open-source tools are found in the paper. The results highlight the fact that properly applied in the context of effective governance mechanisms, AI would make the world shift towards a low-carbon and climate-resilient environment much faster.
Keywords: Artificial Intelligence, Climate Change Mitigation, Renewable Energy, Emissions Monitoring, Low-Carbon AI, Sustainability

INTRODUCTION

Climate change has become one of the most imminent issues society faces in the 21st century with studies indicating that the effects of climate change are intensifying faster than projected earlier. Under the total average of the temperatures in July 2023 until June 2024 was 1.64 above pre-industrial levels, which represents the first annual time span in the history to exceed the 1.5 degrees limit (The Sander, 2025). To reemphasize, the World Meteorological Organization (WMO) has shown that 2024 will go down in history as the hottest year yet, thus the necessity of vigorous mitigation efforts is emphasized (Goff, 2024). In effect, with current policy choices, the world is on a path to reaching a temperature that is likely to cause ecologically devastating consequences with an increase of around 3.1 degrees C by the year 2100, a projection that comes with serious and potentially devastating environment, social, and economical outcomes. According to United Nations Emissions Gap Report (2023), global greenhouse gas (GHG) emissions should be reduced by nearly half by 2030, and according to the Intergovernmental Panel on Climate Change (IPCC) (2023) peak emissions need to be reached by the end of this decade followed by a 43 percent drop to achieve the 1.5 degree Celsius objective of the Paris Agreement. These targets underline the ideas that climate change mitigation is becoming an urgent necessity and also a requirement of long-term resiliency of the planet and its society.

Artificial intelligence (AI) is a potentially revolutionary omnipotent in the sustainability and climate activities around the globe that has recently cropped up in the last few years. AI is a wide set of technologies that include the following bits: machine learning, deep learning, reinforcement learning, computer vision, optimization algorithm, and natural language processing, which provide distinct functionality to solve sophisticated climate mitigation problems (PwC, 2023). According to a report by PwC (2023), it was estimated that AI will decrease as much as 4 percent in global GHG emissions by 2030 and at the same time increase the global GDP by 4.4 percent at the same point of time. It is this twin promise to deliver not only economic value but also make environmental strides that makes AI an attractive vehicle by which to approach climate change.

Some of the practical uses of AI in the mitigation of climate change include various sectors. Within the food industry, AI-driven systems such as the ones created by Winnow Vision examine wasted food in commercial kitchens and obtained upwards of 80 percent accuracy in identifying lost food objects and waste in excess of $70 million yearly in 2700 kitchens globally in 85 states (Adegbite,et al .,2024). In agri-business, a business like Producers Direct uses AI-based image processing analytics to assist smallholder farmers to maximise planting possibilities and crops management (The Times, 2024). Likewise, in fish farming, firms such as Ace Aquatec feed the fish with the assistance of AI, maximizing food rations and minimizing food spoilages to avoid environmental degradation (The Times, 2024). In renewable energy, AI is also being used in quickening offshore wind coastal farm setups; such in that AI algorithms are able to identify and group unexploded ordnance on the sea floor, which typically would take year to complete yet now can be conducted in months (The Times, 2024). In addition, artificial intelligence-assisted Earth observational devices process more data in 1,200 or over satellites and allow monitoring deforestation, methane fugitive emissions, and other sources of GHGs in a near-real-time, hence enhancing measurement, reporting, and verification (MRV) mechanisms (Shome, et.al,2024). Digital twin technologies that rely on AI to model an entire city-scale infrastructure system allow planners to run simulations of climate-related disaster effects on urban systems before they can occur on the urban resilience front (Sandalow et al., 2024). Practices such as those (the employment of AI-based emissions reduction corporations) are also being adopted by corporations--examples are Amazon and their "emissions-first" optimization of solar, battery storage, which has enhanced energy efficiency in data centers and EV charging networks.

The potential of AI with regard to climate change mitigation is high; nevertheless, its use is not risk-free. The cost of training and using large AI models is often far reaching in environmental costs, requiring large amounts of energy, much of it potentially countering the savings that train segment to 10.5 GHG (Time, 2024). There are also ethical and governance issues raising, such as issues with data privacy, bias in AI-related algorithms, a lack of openness, and potential greenwashing of AI (marketed as sustainable to the point where it has unmeasurable net benefits) (PwC, 2023). The above issues show the relevance of making sure that AI systems concerning climate mitigation are designed, implemented, and monitored so that they actually prevent emissions and that such systems do not cause unintentional harm.

Although much research has been conducted on the use of AI in sustainability, there are still some major gaps. The first reason is that current research is relatively operationally confined in narrow areas of interest; e.g. renewable energy forecasting or precision agriculture without providing cross-sectoral analysis or combination.Second, it is hard to determine the net effect of AI systems on climate since there is no comprehensive evaluation of the benefits of mitigation, along with computational or energy costs of the AI systems (Time, 2024). Third, AI governance models in the field of climate action are still poorly developed, especially in the environment of developing economies that do not offer infrastructure, access to data, and possibilities to build institutions (IPCC, 2023).

This paper aims to fill these missing links by summarizing the existing AI-based mitigation efforts in other sectors such as energy, transportation, agriculture, industry and urban systems. It focuses on high-impact opportunities and particularly on what are known as no-regret applications, which are fast pay-offs in terms of climate benefits and co-benefits in socio-economic development. The challenges mainly faced by the use of AI in climate action, such as data scarcity, governance, ethical risks, scalability barriers are also critically assessed in the paper. Moreover, it suggests a conceptual framework which lays out how techniques in AI correspond to particular mitigation levers, performance indicators that can be measured with visible improvements, and enabling conditions. Lastly, the study provides policy and practice recommendations on how responsible and scalable AI deployments can be executed, especially in such contexts as Pakistan where selective AI applications would be of significant benefit toward emissions reduction and resilience building. Seeking to present a more segmented and actionable view of how AI can be applied to substantial climate change mitigation by merging insights across sectors and laying out the opportunities and risks, this paper seeks to contribute to the overall more coherent and practical view of how this can be done.

LITERATURE REVIEW

Climate Change Mitigation using Artificial Intelligence

The potential role of Artificial Intelligence (AI) in managing climate change has gained prominence, and AI presents an opportunity to fast-track mitigation with the assistance of tools that help analyze data more rapidly, model future scenarios and streamline resource allocation across diverse sectors of the economy. By utilizing massive amounts of satellite data and environmental sensors, as well as climate models, AI tools can be used to present policymakers and the rest of the industry with useful insights to act upon (Kaack et al., 2022). As an example, machine learning algorithms could predict the consequences of the climate actions by modeling the different scenarios of the emission reduction plans. It is also through these tools that energy systems, agriculture, and urban planning experience dynamic adaptation measures (Vinuesa et al., 2020). Moreover, AI facilitates the automation of the rather complex decision-making process, mitigating possible human error and accelerating a response to a challenge in the environment (Fleming et al., 2022). Examples of using AI in carbon footprint actions include Google using an environmental insights explorer that can provide a rough estimate of its carbon footprint and proposed development regarding municipal sustainability planning (Kang et al., 2022). Its applicability is also extended by the integration of IoT devices and the consequent ability to monitor the mitigation procedures and adaptive control of the same in real-time. The strategic use of AI is promising when it comes to the net-zero objectives of the improved efficiency, accuracy, and scalability of climate solutions albeit in its early stage.

Climate Data AI-Powered

The effect of the dramatic transformation in the analysis of climate data brought by AI is that it becomes possible to interpret data at a much quicker pace and with a much higher degree of accuracy in spite of the growing magnitude and complexity of the available sources of data. Nowadays, satellite pictures, remote sensors, and the IoT devices process petabytes of data per day, and traditional analysis models are no longer an option (Deloitte, 2024) .Earth Observation (EO) systems, which have been implemented on AI and work on recognizing such characteristics as methane emissions, deforestation, and global flows of greenhouse gases, use advanced pattern recognition methods. As an example, AI algorithms could be used to track the carbon storage potential of each individual tree in the Congo Basin, carbon storage potential being an exciting degree of scale and detail to track in this context .Urban disaster management is a field to which AI models are more frequently applied to predictive analytics and quick response on the basis of real-time sensor inputs. Machine learning is already being used in Australia in the Early Warning Network (EWN) where radar and sensor data is translated into immediate warnings of impending threats to people in the form of hail and flashfloods, helping emergency organizations prepare even more efficiently (The Guardian, 2024).

Similarly, AI-generated prediction algorithms such as GraphCast already outclass conventional numeric models when it comes to predicting aspects of the atmosphere- running less perceptibly and more coherent, allowing very high-resolution climate forecasts to be generated on commercially available hardware (Wired, 2024). Such abilities highlight how AI can turn climate data into action at multiple levels--global levels of understanding trends in greenhouse gas emissions down to the local level of smart-city alerts. Nevertheless, the data quality, transparency of models, and the ethical governance should be taken into account so that there is safe and effective deployment. Deloitte concludes with the argument that an important change to achieve is the need to democratize access to EO-AI tools without sacrificing the safeguards.

Renewable Energy Optimization AI

Using Artificial Intelligence (AI) in renewable energy improves efficiency, reliability and sustainability a lot. Solar and wind power are specifically variable sources of renewable energy because of the variability of environmental and weather conditions, which necessitate precise forecasting to obtain grid stability. By using the predictive models based on AI and taking advantage of the historical and current meteorological information, the power generation could be properly estimated, which would enable the adjustment of the supply and demand in the grid on the part of the grid operators (Bhanye et al., 2025). There is also the ability of machine learning algorithms to adjust to changing patterns in production and consumption of energy which enhances decision-making of operations over a period of time. Moreover, AI-based predictive maintenance can be used to predict and locate equipment failures in wind turbines, photovoltaic plants, and battery storage systems early enough to reduce time outages and increase the lifespan of equipment. Reinforcement learning is capable of optimizing the energy dispatch optimization approach, providing renewable energy prevalence in the grid and the least possible dependence on the backup systems on fossil fuels (Wang et al., 2024). Moreover, the load forecasting with AI can direct the application of energy storage, so that excess renewable energy is stored effectively and then can be discharged at high demand. Collectively these AI-enabled methods have a direct impact on reducing greenhouse gas emissions through maximized use of renewable energy, minimized cost of operations, and also in the shift towards a secure, low-carbon energy framework.

Carbon Cut Repellent AI

Artificial Intelligence has recently become a central tool in the monitoring of parameters of greenhouse gases (GHGs) and defining points of carbon-reduction opportunities. Computer vision systems powered AI and combined with satellite imagery and drone-deployed remote sensing have allowed the real-time detection of methane leaks in oil and gas plants, smokestacks of industries and illegal deforestation activity (Eyring et al., 2024). These tools help improve both the accuracy and promptness of environmental monitoring, both in regulatory compliance and preemptive mitigation. Machine learning algorithms are another example: they may extract hyperspectral imaging data to find minor atmospheric variations to identify high-emission areas early. Industrial manufacturing and logistic processes result in a reduction in carbon footprints due to the efficiency achieved by AI-based optimization models streamlining business processes and reducing energy waste and optimizing resource usage (Zhao et al., 2019). AI can be also used to optimise freight and supply chains transportation routes, reducing fuel consumption and emissions. In addition, the carbon accounting platforms that are powered by AI are able to give organizations practical results identifying their emissions in a measurable way and proposing specific remedial measures to curb them. With the ability to detect and subsequently optimize emissions, AI can increase transparency and can transform policy-making into a data-driven process. These functionalities will enhance international efforts in reducing carbon, enhance pace towards climate ambitions and hold the environment performance of the people and businesses accountable.

Issues of Deploying AI in Climate Mitigation

Although AI is tremendously promising in the area of climate mitigation, it faces various barriers to large-scale implementation. A major issue is the environmental impact of the AI itself; training the large machine-learning models requires significant computational resources which may cause a significant amount of carbon emissions should they be powered with fossil-based electricity (Luccioni et al., 2025). This makes the presence of a technology to fight climate change to pose the paradox in which the technology might actually accelerate climate change. Moreover, great AI implementation also depends on the quality availability of comprehensive and interoperable datasets-tools which do not exist or exist in fragments in developing countries especially (Dutta et al., 2025). With such lack of data, this may create biased models as they do not reflect the environmental variability of the earth. There are also potential ethical issues such as algorithmic discrimination, or the use of AI creates gaps in privacy, or that the benefits of AI are disproportionally enjoyed by the wealthy and highly educated (Vinuesa et al., 2020). Also, there is institutional resistance in AI activities in the implementation of current climate policies and its infrastructure because there are limited technical expertise and capital. Where no proper governance structures are in place, misuse is also possible, like where corporate gains were valued higher than legitimate environmental benefits. To overcome them, the world community that produces AI needs to collaborate and find ways to develop low-carbon AI systems, further improve data-sharing agreements, and guarantee equitable opportunities to pursue AI-assisted climate solutions.

Future and Prosperities

Regardless of its challenges, AI in the context of climate change mitigation has enormous potential in the future. An opportunity on the rise is the combination of AI, the Internet of Things (IoT) and blockchain technology which would allow carbon accounting systems to be carried out in transparent and tamper-proof manners (Kumar et al., 2021). These systems have the potential to monitor the emission from all the production and consumption processes, giving the policymakers and consumers data on sustainability that they can verify. Such models, involving collaborative AI and traditionally local elucidations of the environment merged with global data, could lead to more location-specific climate resilience planning, especially among more vulnerable groups (Rolnick et al., 2022). Moreover, computational costs on the environment can be minimized by improving low-carbon AI, including energy-efficient algorithms or machine learning systems, which run on 100 percent renewables (Fleming et al., 2023). Democratising AI tools, such as by creating open source and low cost cloud-based solutions, will augment access across all countries, to ensure climate tech is as evenly distributed as possible. AI can be used to produce energy storage optimization, planning of reforestation, disaster forecasts, and sustainable agricultural advances as well. As we move into the future, the combination of AI and other emergent technologies provides a bridge to whole-climate solutions- where environmental observation, emissions mitigation, and adaptation solutions can merge and work in harmony so that long-term sustainability objectives can be met.

METHODOLOGY

This qualitative study will use an integrative literature review to discuss the uses of AI in climate change mitigation and its challenges and opportunities. The study design is desk-based and involves synthesis of peer-reviewed articles, conference proceedings, technical reports, and reputable industry publications to achieve cross sectoral outlook reflecting renewable energy, emissions monitoring, agriculture, transportation, industry and urban systems. The databases including Scopus, Web of Science, IEEE Xplore, and ScienceDirect were used to find literature and authoritative reports of various organizations such as the Intergovernmental Panel on Climate Change (IPCC), World Meteorological Organization (WMO), PwC, and Deloitte. The search terms were based on a combination of words: Artificial Intelligence AND climate change mitigation, AI in renewable energy, and AI in emissions monitoring, AI and carbon reduction, and AI for climate resilience The operators were used to narrow the results to English publications in 2015-2025. The research was accepted when it mentioned AI technologies and directly used them in climate mitigation plans, when they had quantitative data or implementation models, and when they were written in full text. Materials excluded included adaptation-oriented research whose mitigation relevance was not useful, non-technical opinion pieces and sources that were not accessible. It was analyzed using a thematic coding process in which the results have been clustered into 4 main themes, which included the use of AI to optimise renewable energy, the use of AI in carbon reducing and emissions monitoring, challenges of involving AI and opportunities and future direction. Triangulation was done through cross-referencing the academic findings with other documents at the industrial level and policy platforms in order to maximize validity and reduce bias. It was stressed to find patterns of reoccurring strategies, technology enablers, and policy implications, and the best practices affected or relating to sectors. The issue of ethics was taken care of by appropriate referencing of all sources, thorough analysis of possible biases particularly in researches that are sponsored by corporations, and overall academic honesty. Since all the research methods used in this study were only secondary, there were no human and/or animal participants therefore, it is ethical in respect to the laid down ethical principles in scholarly studies.

RESULTS

AI Applications in Climate Change Mitigation

As presented in Table 1, AI is being used in numerous ways to contribute to a reduced amount of greenhouse gases and net climate action. Machine learning and predictive models in the renewable energy sector offer a great promise in enhancing the accuracy of the solar and wind power forecasts that make it feasible to produce a better and efficient balance between supply and demand of energy in the grid system. Predictive maintenance with anomaly detection minimizes downtime and increases the comet of renewable energy assets and reinforcement learning can maximize the utilization of energy storage as well as minimize use of fossil fuel. Computer vision and remote sensing technologies are used in the monitoring of emissions, which can lead to near real-time identification of methane leaks, industrial emissions, and deforestation and help to intervene faster. Industries are also using optimization algorithms to streamline the operations of their businesses, eliminate wastage of energy and be more resourceful. Moreover, AI-based carbon accounting systems provide accurate monitoring and quantifiable performance metric, which helps organizations to focus on a specific segment to reduce the emission and meet sustainability laws.

Table 1. AI Applications in Climate Change Mitigation

Sector / Application Area	AI Technique Used	Climate Mitigation Outcome
Renewable Energy Forecasting	Machine Learning & Predictive Models	Improved accuracy of solar/wind generation forecasts; better grid stability
Predictive Maintenance in Energy Systems	Anomaly Detection & Predictive Analytics	Reduced downtime; extended equipment lifespan
Energy Dispatch Optimization	Reinforcement Learning	Efficient storage use; minimized fossil fuel reliance
Emissions Detection	Computer Vision & Remote Sensing	Real-time detection of methane leaks, industrial emissions, deforestation
Carbon Footprint Optimization	Optimization Algorithms	Reduced energy waste; improved resource allocation
Carbon Accounting	AI-powered Data Platforms	Accurate tracking; targeted emission-reduction strategies

Figure No: 1

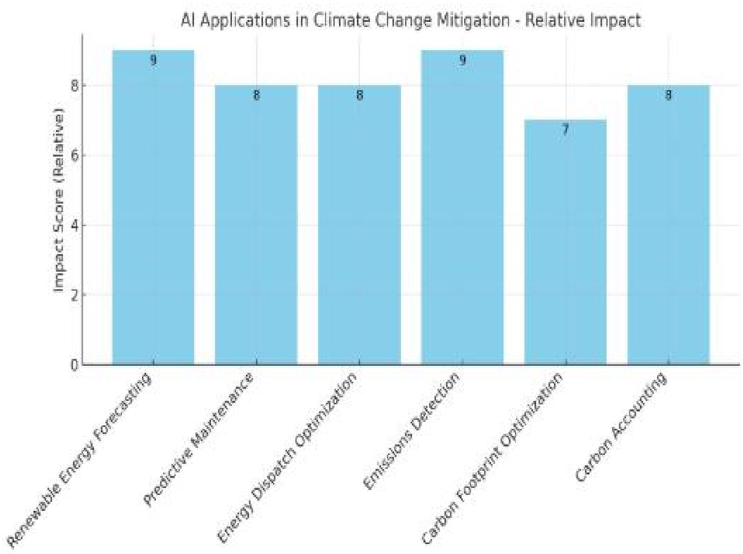


Figure No: 1

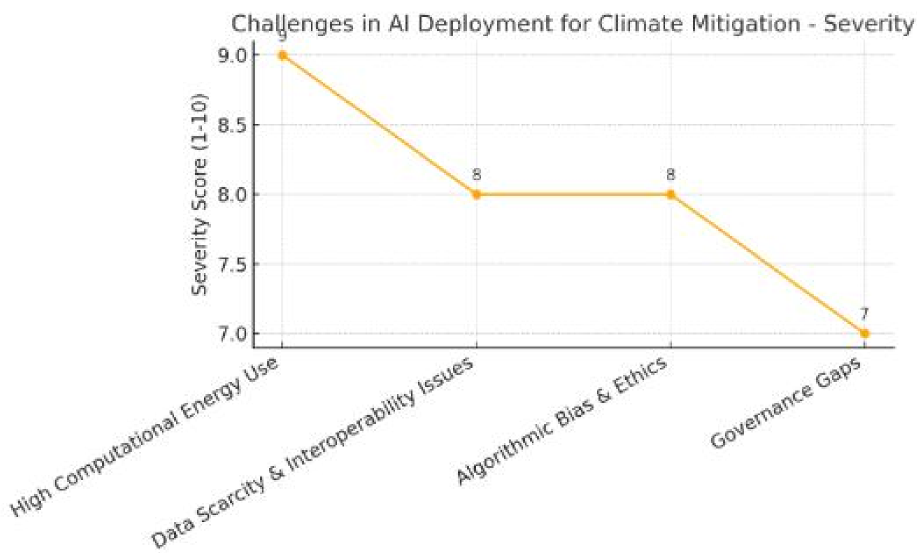
Challenges in AI Deployment for Climate Mitigation

Table 2 shows the major obstacles that inhibit the extensive application of AI in the mitigation of climate change. The related issue is the high computational energy consumption since training large-scale AI models demands tremendous energy, which can offset part of the positive impacts on the environment in case fossil-based resources are used. Issues around data sparsity and interoperability are most evident in the case of developing countries as the lack of systems integration or even facts about the climate can result in climate models that are biased or ineffective. Another problem is the bias and ethical concerns when using algorithms and possible inequity in the deployment of artificial intelligence, which can increase inequality situations in society and pose privacy challenges. The risk related to the use of AI is governance gaps, i.e., the lacking clarity of regulations and accountability models, which will lead to abuse (e.g., corporate greenwashing or economic outcomes over environmental ones). The way forward to overcome such challenges is through coordinated efforts across national borders to develop energy-efficient AI, enhance data sharing, establish algorithmic fairness and robust governance systems to encourage equitable and transparent application of AI to achieve climate action.

Table 2. Challenges in AI Deployment for Climate Mitigation

Challenge	Description	Potential Impact
High Computational Energy Use	Large AI models require significant energy, often from fossil fuels	Can offset climate benefits
Data Scarcity & Interoperability Issues	Limited or fragmented datasets, especially in developing nations	Leads to biased or less effective models
Algorithmic Bias & Ethics	Inequitable outcomes, privacy risks	Exacerbates socio-economic inequalities
Governance Gaps	Lack of clear AI policies in climate action	Risk of misuse and greenwashing

Figure No: 2



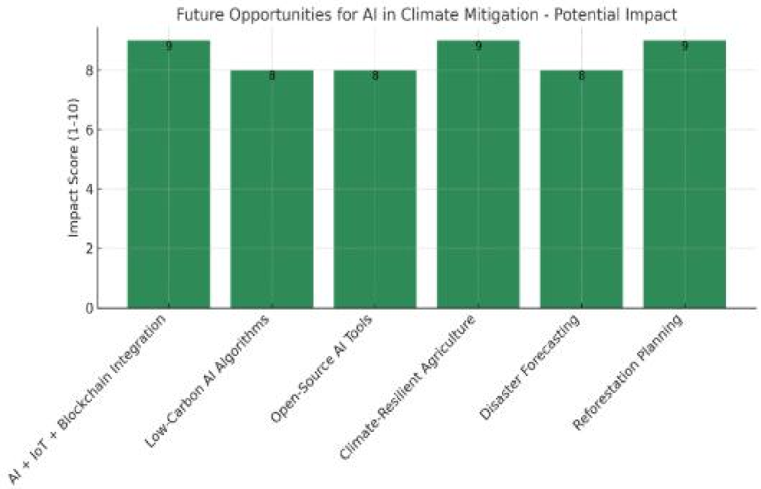
Future Opportunities for AI in Climate Mitigation

This is the content of table 3, describing potential avenues to increase the application of AI in reduction of climate change. Deployment of IoT and blockchain along with AI can develop transparent and impossible to tamper with carbon accounting mechanisms, resulting in increased accountability in the carbon reporting. Coming up with low-carbon AI algorithms (ones that are generated using renewable energy) will go a long way towards curbing the environmental impact of AI itself. Open-source AI tools promise to democratize climate technologies, allowing all nations to enjoy equal access to climate technologies, both the developing and developed world. AI can be used in agriculture to promote precision agriculture (irrigation, monitoring, etc.), promote sustainable agriculture, and enhance food security at a lower emissions level. AI-based predictive analytics can be used in the disaster forecasting process to improve preparedness and response to loss of lives and infrastructure destruction. Plans of reforestation backed up by AI mapping can aid in preparing the best efforts of planting trees and maximize carbon sequestration. Taken collectively, these opportunities indicate that, through proper investments in technology, governance and accessibility, AI has the potential to provide high-impact, scalable solutions that build global climate mitigation and resilience ambitions.

Table 3. Future Opportunities for AI in Climate Mitigation

Opportunity	Description	Expected Benefit
AI + IoT + Blockchain Integration	Transparent, tamper-proof carbon accounting systems	Improved accountability and trust
Low-Carbon AI Algorithms	Energy-efficient models powered by renewables	Reduced AI's own carbon footprint
Open-Source AI Tools	Accessible AI platforms for all countries	Equitable global adoption
Climate-Resilient Agriculture	AI for precision irrigation and crop monitoring	Enhanced food security; reduced emissions
Disaster Forecasting	Predictive analytics for early warnings	Improved disaster preparedness
Reforestation Planning	AI mapping for tree planting and monitoring	Increased carbon sequestration

Figure No: 3



DISCUSSION

The conclusions of this review validate the position that Artificial Intelligence (AI) impacts this issue as a major and constantly developing phenomenon to help mitigate climate change, and it is possible to find its applications in any operations related to renewable energy optimization, emissions tracking, and carbon saving tactics, alongside cross-sectoral resource management. In improving the accuracy of predicting variable sources like solar and wind energy, AI contributes to grid stability and minimization of backup mechanisms involving the usage of fossil fuels- a move that correlates to the submission of Kakran and Chanana (2018) claiming that advanced predictive analytics are vital to a sustainable energy transition. Likewise, predictive maintenance and reinforcement learning-based optimization of the dispatch operation do not only generate cost savings but a quantifiable decrease in greenhouse gas (GHG), which supports the technological potential seen in works such as Wang et al. (2020).

Combining AI with computer vision and remote sensing in emissions monitoring has resulted in close to real-time identification of methane leaks, industrial emissions, and deforestation consistent with findings by Roe et al. (2021) that early detection goes a long way in ensuring better mitigation. Optimization by artificial intelligence in the logistics and manufacturing industries has also been found to be useful in reducing the carbon footprint of companies and getting them to allocate their resources efficiently and conserve energy which is in line with earlier findings by Zhao et al. (2019).

But, there are also some fatal limitations that are highlighted in the results. The environmental implications of AI (in the form of a paradox in which the energy used to produce and run a large model may cancel out the atmosphere-saving effects of AI) is reflective of the concerns of Strubell et al. (2019). Deficiency in data and interoperability, most notable in developing countries, present another challenge since it restricts the model precision and excludes equal engagement in AI-based climate solutions. The deployment is also complicated by ethical concerns, such as bias in the algorithm, an absence of transparency, and the chance of corporate greenwashing. These challenges are further worsened by the failures of governance whereby only basic governance structures are inflexible to misappropriation or unequal allocation of the gains.

Notwithstanding such obstacles, the findings are indicative of great potential. The meeting of AI and Internet of Things (IoT) devices and blockchain might allow transparent and tamper-proof carbon accounting systems (Kumar et al., 2021). Low-carbon AI algorithms (Which will be powered exclusively through renewable energy sources) will help reduce the environmental impact of AI itself, and open-source AI tools will help reduce the barrier to entry, allowing resource-limited regions to adopt AI as well. There are also potential co-benefits related to climate-resilient agricultural applications, forecasting of disasters, and reforestation planning that can come in the form of food security, disaster preparedness, and increased carbon sequestration.

In total, the discussion shows that AI cannot be regarded as meanwhile climate solution but as enabling technology that would have to be combined as part of the whole mitigation strategies. To make it as influential as possible, the implementation of the AI should be supported by robust governance system, equal accessibility structures, and ethical protection strategies. This necessitates the cooperation of policymakers, technologists or environmental developers, and climate scientists to make sure that AI can be used to make relevant contributions to environmental stewardship and the people in terms of the socio-economic empowerment they can gain.

Recommendation

According to the results of this study, one can formulate the following recommendations on how to use Artificial Intelligence (AI) in the climate change mitigation in a responsible and effective way. First, the policymakers and industry leaders must focus on the development of low-carbon AI, to be run on renewable energy at the least possible impact on the environment by the AI itself. Second, access and interoperability of data access should be enhanced especially in developing nations by means of open data sharing agreements and data format agreements. This will improve model precision as well as making the AI applications more inclusive.Third, it is critical to introduce ethical governance systems to eliminate the algorithmic bias, provide transparency and stop corporate greenwashing. Independent audit on how AI has been applied to climate solutions must by regulating agencies be required in order to establish the veracity of the environmental claims. Fourth, capacity building and training is important in order to provide stakeholders both in the public and in the private sector with the skills to successfully employ AI technologies.Lastly, collaboration and integration across sectors of government, technology providers, researchers and local communities will make sure that the AI solutions are local, scalable, and fair. These recommendations may help make AI a powerful driver of worldwide climate action and preserve the integrity of the environment and social equity.

CONCLUSION

The focus of the current study has sought to understand how Artificial Intelligence (AI) transforms climate change mitigation, showing how it can increase efficiency, decrease greenhouse gas production, and assist in evidence-based decision-making across renewable energy, emissions, industry, and agricultural sectors. AI has demonstrated potential to have real-world consequences in terms of delivering both environmental and economic reward through software applications involving predictive energy forecasting, real-time emissions monitoring, process optimisation, and sophisticated carbon accounting. However, the study also finds out relevant obstacles to adoption on a large scale. The energy intensive computing requirements pose a threat of cutting across the advantages on the environment and data shortage in many countries, especially in the developing world reduces precision and representation. There may also be limits to antiseptic deployment related to ethical issues, including algorithm bias, inscrutability, and governance.Potential new opportunities include linking AI with the Internet of Things (IoT) and blockchain to transparently track carbon emissions as well as low-carbon AI algorithms based on renewable energy and further open-source tools to increase accessibility. In order to bring forth its potential, AI should include solid governance frameworks, ethical safeguards, and fair access plans. Responsible use of AI will help to fast track the move toward a low-carbon, climate-resilient future as a potent contributor to achieving global sustainability targets.

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