Emirati Journal of Business, Economics and Social Studies
Vol 4 Issue 2 (2025)
Pages (254 - 268)

Available at
www.emiratesscholar.com

AI in a Dual Challenge: Creative Remedies for the Hunger and Climate Disasters

Fayrouz Attia
Urgent Tasks Section Head, at the Cabinet IDSC
*Corresponding author: fayrouz_ahmed@hotmail.com

ARTICLE HISTORY

Received: 10 November 2025.
Accepted: 01 December 2025.
Published: 15 December 2025.

PEER REVIEW STATEMENT:

This article underwent double-blind peer review by 3 independent reviewers.

HOW TO CITE

Attia, F. (2025). AI in a dual challenge: Creative remedies for the hunger and climate disasters. *Emirati Journal of Business, Economics and Social Studies*, **4**(2), 254–268. https://doi.org/10.54878/0ve8qv81

ABSTRACT

No doubt that Artificial intelligence (AI) is shaping the current era. At the same time, climate change is putting agriculture under immense stress—especially in vulnerable, low-resource areas. Rising temperatures, erratic weather, and recurring disasters like droughts and floods are threatening global food production. In this context, sustainable agriculture has become essential for reducing risks and protecting food systems. Nowadays, AI offers powerful solutions. It can forecast climate trends, monitor crop health, and optimize resource use. Through tools like machine learning and computer vision, AI enables smarter farming—helping farmers choose ideal planting windows, detect pests early, and adapt to shifting conditions, to achieve stronger resilience and higher amounts of yields. However, integrating AI into agriculture isn't without challenges. Many developing regions lack the digital infrastructure, finance, and high-quality data needed for effective AI use. While global investment in AI is rapidly growing—with projections reaching $1.39 trillion by 2029—the benefits are unevenly distributed. Added to the environmental concern about the cost of AI, such as high energy use and reliance on scarce materials. To ensure AI contributes to sustainable agriculture and climate action, its development must be guided by ethical principles that promote fairness, transparency, and environmental care. Within this context, this study aims to analyze the current state of the problem, establish sound foundations for its solution, propose several future scenarios, and present a comprehensive set of actionable recommendations for decision-makers.

Keywords: *AI,climate change, food,cost*

Research Problem

The research focuses on four key areas: the impact of climate change on food production, the use of AI in climate forecasting, its role in sustainable agriculture, and the challenges holding back wider adoption. It highlights how AI can improve yields, reduce waste, and help the most vulnerable. The study's goal is to deliver a flexible and evidence-based framework & scenarios that shows governments and decision-makers how to responsibly integrate AI into agriculture to confront today's food and climate crises.

Methodology

This study adopts a descriptive-analytical methodology and scenario-based approaches, drawing on a combination of qualitative and quantitative data to explore the role of artificial intelligence (AI) in mitigating the effects of climate change on food security and sustainable agriculture. The research is based on a comprehensive review of peer-reviewed scientific articles, previous studies, official reports, international experiences, and prominent sustainable agricultural practices. The analysis is based on internationally recognized datasets and indicators, including those related to the integration of AI in the agricultural sector, climate change metrics, and food security. This data is sourced from reputable international organizations.

Introduction:

According to the World Risks Report 2025, the risk of climate change ranked second among the group of risks included in the index globally, indicating the need to address this issue, which has a profoundly harmful impact on the world's food, water and environmental security.

Climate change and food insecurity are two of the most pressing and interconnected global crises of our time. Rising temperatures, shifting precipitation patterns, and the increasing frequency of extreme weather events—such as droughts, floods, and heatwaves— All of these are phenomena that require placing unprecedented pressure on agricultural systems worldwide. These environmental disruptions not only threaten crop productivity but also risk destabilizing ecosystems, diminishing biodiversity, and intensifying hunger in vulnerable regions. In this high-risk context, ensuring sustainable, resilient food systems has become a global imperative, requiring innovative approaches that go beyond traditional farming methods.

Artificial Intelligence (AI) has emerged as a powerful tool for addressing the dual challenges of climate change and hunger. By integrating machine learning with data from climate models, soil sensors, satellite imagery, and crop genetics, AI can support more adaptive and efficient agricultural practices. These technologies enable farmers and decision-makers to predict risks, optimize resource use, and enhance yield stability despite volatile environmental conditions. This study examines how AI can be leveraged to build climate-smart agriculture, identifying its potential to mitigate disruptions, increase food security, and promote sustainable development globally. It also addresses the technical, economic, and ethical barriers that must be overcome to scale these solutions equitably and effectively.

1. Conceptual and Theoretical Framework

1.1 The concept of global AI:

Artificial intelligence has been defined in multiple ways across disciplines. Copeland and Proudfoot (1993) describe it as "the process of developing computer systems capable of performing tasks that typically require human intelligence, such as visual perception, speech recognition, decision-making, and language translation."

AI is also defined as the type of machine intelligence that emerges when systems are programmed with algorithms and software that enable them to mimic human cognitive processes. Oracle defines AI as "systems or devices that simulate human intelligence to perform various tasks and continuously improve based on the data they collect. These systems possess advanced analytical capabilities and high-level reasoning."

From these definitions, two foundational elements of AI become clear:

- **Sophisticated software systems** designed to replicate aspects of the human mind
- **Big data**, which serves as the vast resource upon which AI systems operate, analyze, and make informed decisions. (Attia,2023)

1.2 The Concept of Global Food Security

Global food security refers to the **consistent availability, accessibility, and utilization of sufficient, safe, and nutritious food** necessary to support active and healthy lives for all populations. According to the Food and Agriculture Organization (FAO, 2022), approximately **2.4 billion people**—representing **29.6% of the world's population**—faced moderate to severe food insecurity. Armed conflicts and political instability Economic downturns at local or national levels are causes for insecurity.

Figure 1: Food Security Keys

Source: Compiled by the researcher

Availability - Ensuring that sufficient quantities of food are produced and supplied

Access - Guaranteeing that people have the means to acquire food

Utilization - Promoting dietary diversity and proper nutrition to make food biologically useful

Stability - Minimizing fluctuations in availability and access due to crises. (Metych,2025)

1.3 The Concept of Climate Change

The Earth's climate is undergoing unprecedented change. Scientific evidence confirms that the current warming trend is advancing at a rate not observed in thousands of years. Human activity—primarily the burning of fossil fuels—has led to a significant increase in greenhouse gases, trapping more solar energy within the Earth's system. This trapped energy has caused: Warming of the atmosphere, oceans, and land, melting of glaciers and polar ice, rising sea levels and shifts in ecosystems and biodiversity

According to the Intergovernmental Panel on Climate Change (IPCC), the **global average surface temperature is now approximately 1.2°C higher than it was in the late 19th century**, marking the highest levels seen in over **100,000 years**.

Climate change refers to **long-term, significant alterations in average weather patterns**—including temperature, precipitation, and wind—occurring over decades or longer. These changes may result from:

- **Natural causes**, such as volcanic eruptions, tectonic shifts, or variations in solar radiation
- **External forces**, like meteorite impacts
- **Human activities**, industrial emissions, deforestation, and land use changes

The **United Nations Framework Convention on Climate Change (UNFCCC)** defines climate change specifically as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods." It is known that **Global Temperature Targets** is to limit the rise to **no more than 1.5°C above pre-industrial levels** by the mid-21st century. (UN,n.d)

1.4 Artificial Intelligence as a Catalyst for Resilience in an Era of Global Shocks

In a crisis-stricken world, AI represents both a shield against immediate threats and a scaffold for long-term sustainability. Its ability to synthesize complex data, predict systemic risks, and optimize resource allocation positions it as an indispensable ally in the fight against climate change and hunger. However, realizing these potential demands proactive governance, equitable technology distribution, and a commitment to aligning innovation with planetary and human well-being. The coming decades will test humanity's capacity to harness AI not merely as a technological tool, but as a cornerstone of global resilience.

Climate-smart agriculture (CSA) helps farmers adapt to a changing climate by making crops stronger, using fewer resources, and keeping yields steady.AI tools make this possible by analyzing weather history, soil quality, and crop traits to suggest smart farming choices. These tools are becoming essential as the planet warms—scientists expect a 3°C rise by 2100. That level of heating could triple extreme weather events like droughts, floods, and heatwaves, threatening food production and deepening hunger worldwide.

The compounding effects of climate change threaten not only crop productivity but also ecological balance. Prolonged droughts and erratic rainfall patterns degrade arable land, while extreme weather events disrupt pollinator populations and soil microbiomes, further jeopardizing biodiversity. AI tools offer a dual advantage: predictive analytics can forecast these disruptions, enabling preemptive interventions, while precision agriculture minimizes environmental footprints by optimizing water, fertilizer, and pesticide use. For example, satellite imagery combined with machine learning algorithms identifies at-risk ecosystems, guiding targeted conservation efforts.

Recent studies confirm that the use of artificial intelligence contributes to overcoming, adapting and mitigating the severity of climate change through many mechanisms and applications. It measures emissions and contributes to removing current emissions from the atmosphere, as it can reduce greenhouse emissions by a percentage ranging between (5-10)% of the carbon footprint of industrial institutions.(Johns Hopkins University. (2023)

In the agriculture sector, AI technologies such as smart irrigation systems, drones to monitor crops, and autonomous machines powered by AI are being used to improve efficiency and reduce reliance on human labor. For example, John Deere's "See & Spray" technology uses machine learning to selectively spray herbicides, reducing the use of chemicals. Additionally, platforms such as IBM's "Watson" help farmers make informed decisions based on analysis of big data, such as weather forecasts and crop conditions. (Hung, S. K.-C., & Siddiqi, Y. (2024))

Table 1: Examples for using AI tools to face climate change effects

AI Application	Benefit	Example
Crop Prediction Models	Improve yield forecasts and reduce losses	IBM Watson predicts crop failure based on weather data VentureBeat. (2018)
Climate Pattern Analysis	Identify trends in rainfall, temperature, and drought risks	Climate AI platform uses ML to assess agro-climatic zones Gupta, H. (2023)
Smart Irrigation Systems	Optimize water usage based on real-time soil and weather data	Net Beat by Netafim provides real-time irrigation decisions NetBeat. (2020)
Pest and Disease Detection	Prevent outbreaks by early	Plantix app identifies diseases from

	detection using image recognition	leaf images Plantix. (n.d.)
Drone-based Mapping and Monitoring	High-resolution mapping of crops and soil conditions	Drones monitor nutrient deficiencies or pest spread Morning Ag Clips. (2025)
Supply Chain Optimizatio n	Enhance logistics by predicting weather impacts on transportatio n routes	Blue Yonder AI forecasts disruptions and suggests rerouting. Blue Yonder. (n.d.)
Disaster Prediction and Early Warning	Minimize crop loss through early alerts for floods, droughts, etc.	Sipremo AI predicts floods in Brazil . (WEF,2024)
Carbon Emissions Monitoring	Track emissions from farming activities and support mitigation strategies	AI models estimate emissions in real-time from satellite data.
Precision Agriculture Decision-Making	Enable data-driven farm management decisions	John Deere's "See & Spray" reduces unnecessary herbicide use. MachineFinder . (2024)

1.5 Challenges Facing AI at the Intersection of the Hunger Crisis and Climate Change

Despite its promise, AI's role in crisis mitigation faces significant hurdles. Climate models require vast, high-quality datasets to generate accurate predictions—a challenge in regions with limited meteorological infrastructure. Additionally, the integration of AI into smallholder farming systems demands affordable technology access and digital literacy training for rural communities. Ethical considerations, such as data sovereignty and algorithmic bias, further complicate equitable implementation. (The Columbia Climate School. 2018)

Using artificial intelligence to tackle climate change and food insecurity holds real promise, but it also comes with tough challenges. As the global population heads toward 10 billion by 2050, At that time the pressure on food systems will intensify. AI can help make agriculture more efficient—but only if it has access to large, high-quality datasets. That's a problem, especially in many developing countries where such data is scarce or unreliable.

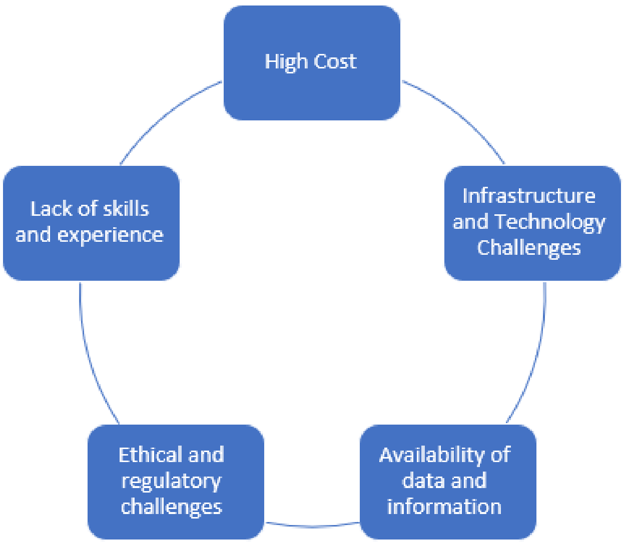
Another major hurdle is the complexity of climate systems themselves. Weather patterns are chaotic, interconnected, and constantly shifting. Training AI to understand and predict these dynamics is no easy task. When models are built on incomplete or biased data, the predictions can be off-base—and that risks misleading farmers, policymakers, and development agencies who rely on them to make big decisions. (Tractor Junction.2024)

Other challenges include ensuring that AI solutions are implemented fairly and ethically, as these technologies can exacerbate social and economic inequalities if they are not designed with the needs of diverse communities in mind. For example, communities with limited resources may not benefit sufficiently from AI technologies, widening the gap between rich and poor countries. Lack of adequate technological infrastructure and computing resources also hinders the widespread implementation of these technologies. (Jobin, A., Ienca, M., & Vayena, E. 2019)

At all the difficulties of interpreting the results of AI models, especially deep learning models that are considered "black boxes" due to their complexity. This reduces users' confidence and limits their reliance on these technologies in making climate decisions. In addition, integrating AI with traditional climate models, which have been developed over decades, requires significant efforts to ensure compatibility and effectiveness. (Doshi-Velez, F., & Kim, B. 2017).

Therefore, from what was previously presented, Ethical and regulatory challenges require clear policies to ensure the responsible use of AI, including data protection and transparency. The limited ability of AI models to adapt to different geographic and climatic conditions also limits their global application. Finally, the lack of expertise and skills needed to develop and operate these technologies is an additional challenge, requiring investments in education and training to build a workforce capable of using AI for sustainability. (Vinuesa, & Others, 2020)

Figure 2: The most prominent challenges facing the use of artificial intelligence.



Source: Compiled by the researcher

2. AI Adoption, Climate Change, Global Hunger Performance Metrics, and Emerging Trends in Smart Agriculture

2.1 Food Security Indicators: Latest Trends and Progress Toward Zero Hunger

Global hunger levels measured by the *Prevalence of Undernourishment (PoU)*, corresponding to **SDG Indicator 2.1.1** have remained largely unchanged since the sharp rise observed between 2019 and 2021. As of 2023, approximately 9.1% of the world's population experienced hunger, compared to **7.5% in 2019**.

- This equates to an estimated **733 million people** facing undernourishment in 2023, using the mid-range of the projected range (**713-757 million**), which mean that it represents an **increase of 152 million people** compared to 2019.

Food Insecurity According to regions (SDG Indicator 2.1.2)

- In 2023, **58.0% of the population in Africa** experienced **moderate or severe food insecurity**, **nearly double** the global average, in contrast, food insecurity prevalence rates were:
  - **Asia**: 24.8%
  - **Latin America and the Caribbean**: 28.2%
  - **Oceania**: 26.8%

These figures highlight persistent vulnerabilities and growing inequalities in food access, driven by economic shocks, conflict, and climate extremes. FAO,(2024)

The **2024 Global Hunger Index (GHI)** reports a global score of **18.3**, categorized as *moderate* a marginal improvement from **18.8 in 2016**. Despite this slight global progress, the overall pace has slowed **dramatically** over the past decade. Based on the current trajectory since 2016, **Zero Hunger** (SDG 2) will not be achieved until **2160—130 years** beyond the 2030 target.

The 2024 GHI underscores how hunger is intensified by interlinked global crises:

- **Armed conflicts** and political instability (e.g., Gaza, Sudan, Trump's business and political decisions)
- **Climate shocks** and extreme weather
- **High food prices** and **market disruptions**
- **Economic recessions**, debt burdens, and fragile social protection systems
- Rising **internal displacement**—over **115 million people** have been forced to migrate due to conflict, persecution, or environmental disasters. Global Hunger Index. (2024).

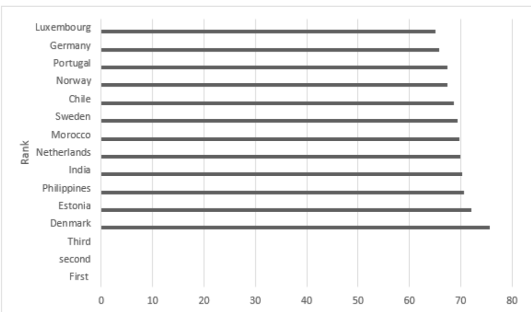
2.2 Global Climate Performance Index (CCPI) 2024

The *Climate Change Performance Index* (CCPI) serves as a critical tool for evaluating countries' progress in climate action. It assesses performance across four key indicators:

- **Greenhouse Gas (GHG) Emissions**
- **Renewable Energy Deployment**
- **Overall Energy Use**
- **Climate Policy Implementation**

Based on these dimensions each country receives a composite score, In the 2024 CCPI ranking, **Denmark** secured the top position, followed by **Estonia** and the **Philippines**. Despite these rankings, the report underscores a concerning reality: no country has made adequate progress in reducing emissions to align with the 1.5°C **Paris Agreement target**. Additionally, no nation received a "high" rating in the climate policy category, reflecting a global shortfall in ambitious and enforceable climate governance. This performance gap highlights the urgency for countries to enhance both national policy f AI and machine learning (ML) are emerging as pivotal tools in the fight against climate change, offering transformative capabilities to analyze energy consumption patterns, optimize grid operations, and prevent waste across industries. According to the International Energy Agency (IEA), integrating AI into energy systems could slash global greenhouse gas emissions by 4% by 2030—equivalent to removing 2.4 gigatons of CO_2 from the atmosphere frameworks and implementation mechanisms to meet international climate goals. Datategy. (2023)

Figure 3: The ranking of developed countries in the Global Climate Performance Index for 2024



Source: Ccpi organization, The annual Climate Change Performance Index 2024

On The other hand, the air quality index is also one of the basic indicators that are directly linked to climate change, especially in cities. The use of artificial intelligence technologies contributes to reducing pollutants such as nitrogen oxides, sulfur and fine particles. Improvements in air quality can be monitored through indicators such as the AQI (air quality index) which measures pollutant concentrations. In addition, artificial intelligence contributes to reducing negative environmental impacts such as deforestation, as it is expected that 32 million hectares of forests will be saved by 2030 thanks to the use of artificial intelligence technologies. PWC, (2024).

Also, the energy efficiency index shows the impact of artificial intelligence applications in improving energy consumption in buildings and industries. For example, intelligent algorithms help optimize heating, ventilation, and air conditioning systems, which reduces energy consumption. Energy efficiency can be measured by monitoring energy intensity across sectors, with reducing energy intensity leading to higher energy efficiency EIA. (2021). On the other hand, AI helps increase the presence of renewable energy in the energy mix, by improving the accuracy and reliability of forecasting its capacity, which enhances environmental sustainability. REN21. (2020)

2.3 AI Adoption in Agriculture Sector: Global Trends

The global AI in agriculture market reached a valuation of USD 2.18 billion in 2024, with projections forecasting a surge to USD 12.95 billion by 2033, reflecting a robust compound annual growth rate (CAGR) of 19.48% from 2025 to 2033. In 2024, North America leads the market, accounting for over 36.8% of the global share. This dominance is fueled by the region's emphasis on precision agriculture to optimize crop productivity and the accelerating integration of IoT-enabled sensors and data analytics into farming operations.

The software segment emerged as the largest offering in the AI in agriculture market in 2024, capturing approximately **55.9% of the global share**. This dominance stems from the accelerating adoption of AI-powered tools—such as decision support systems, farm management platforms, and data analytics solutions—by agricultural enterprises and individual farmers. These software services deliver critical functionalities, including **irrigation management, real-time crop monitoring, yield forecasting, and pest detection**, enabling precision agriculture through data-driven insights. By leveraging AI algorithms, farmers can optimize crop productivity, minimize environmental impact, and enhance resource efficiency while making informed operational decisions. Machine learning dominated the AI in agriculture market in 2024, accounting for **53.3% of the global share**, and remains the largest technology segment. Its prominence is rooted in its ability to analyze vast datasets from sensors, satellites, and drones. IMARC Group. (2025)

Farm management emerges as a key area of technological integration, with IoT and AI solutions utilized in 35% of applications. These tools enhance operational efficiency through real-time data analytics, automated decision-making, and resource allocation. Precision farming and irrigation monitoring each hold 16% of the market, reflecting a growing emphasis on data-driven resource management to mitigate water scarcity and improve crop yields. Pangarkar, T. (2025)

The market's expansion is propelled by three primary factors: the escalating demand for precision farming, mounting global food security challenges, and the pressing need to optimize resource efficiency. Concurrently, advancements in machine learning, robotics, and IoT technologies—combined with government policies advocating smart agriculture—are accelerating adoption rates and fueling robust market growth.

3. A global analytical view on leveraging artificial intelligence to tackle hunger and climate change

AI holds great promise for tackling the complex relationship between hunger and climate change. As climate conditions grow more unpredictable, AI can help farmers adapt, protect crops, manage resources, and build more resilient food systems. But like any tool, AI comes with both advantages and limitations. Below is a simplified look at the strengths, weaknesses, opportunities, and threats tied to AI use in agriculture:

Table 2: Highlights of International Experiences in Using Artificial Intelligence to support sustainability

Country	
UAE	The UAE has prioritized AI-driven precision agriculture and climate-smart food systems through initiatives such as AIM for Climate. These technologies have enhanced resource efficiency, attracting substantial agritech investments and improving agricultural productivity. However, scaling these solutions faces barriers, including data privacy concerns and the need for cross-sector collaboration among stakeholders. (Ministry of Climate Change and Environment.) (2024)
India	In India, initiatives like "Saagu Baagu" in Telangana state, run by Digital Green in collaboration with the World Economic Forum, have improved the productivity of 7,000 chili pepper farmers. This initiative uses multilingual chatbots to provide

	personalized agricultural advice, improving quality and reducing resource use. Financial times, (2025)
Germany	Germany focuses on AI applications in energy efficiency and renewable integration, achieving notable reductions in carbon emissions through smart grid management. Despite progress, high implementation costs and a shortage of specialized technical expertise hinder broader adoption. Hoffmann, M. (2024)
United Kingdom	The UK excels in climate modeling and biodiversity monitoring, producing high-resolution projections to guide policy. Public skepticism regarding data usage and ethical concerns over AI surveillance necessitate transparent governance frameworks. Green, E. (2024)
Scotland	Scotland's AI-driven deforestation monitoring systems provide accurate carbon sequestration measurements, supporting reforestation goals. Challenges involve processing large satellite datasets and accessing high-resolution imagery. Masterson, V. (2024)
Kenya	In Kenya, farmers use tools like Virtual Agronomist and PlantVillage to receive personalized recommendations on fertilizer and pest control. For example, farmer Sami Salim has tripled his coffee yields thanks to these tools. The Guardian.(2024)
United States	The US implements AI for energy efficiency and deforestation tracking, reducing industrial energy consumption and enhancing environmental monitoring. Regulatory fragmentation and data privacy debates complicate cross-state implementation. Adams, S. (2033) In the U.S., AI is revolutionizing agricultural practices through **Precision Agriculture**: AI technologies are used to optimize resource use, such as reducing water consumption by up to 30% through smart irrigation systems. Farmout (n.d)
China	Chinese company Pinduoduo is organizing its annual Smart Farming Competition, where teams used AI technology to grow strawberries in greenhouses. Results showed that the AI teams outperformed traditional farmers by 196% in productivity and 75.5% in economic efficiency. Zhang, Bonnie(2020)

Source: Compiled by the researcher

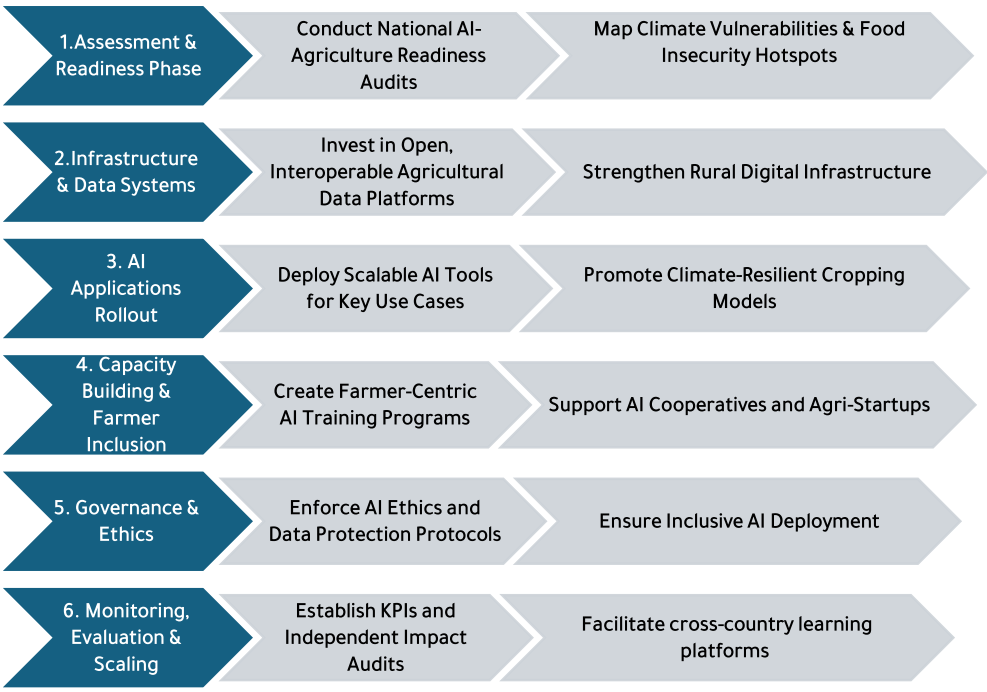
Table 3: SWOT Analysis for using AI to face Global Hunger and Climate Change

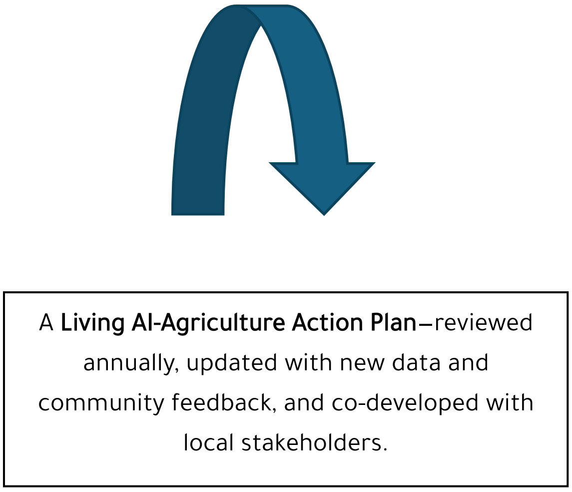
Strengths	Weakness
• Enhances precision in resource use (water, fertilizers, pesticides), reducing waste and increasing crop yields • Predicts extreme weather events using climate data, enabling proactive risk management	• High initial costs for AI tools and maintenance hinder adoption, especially for smallholder farmers • Lack of technical skills among farmers creates a need for training and support

• Automates farming tasks (planting, harvesting, monitoring) with drones and robots, reducing labor needs and costs • Enables real-time monitoring of soil, weather, and crops for faster, data-driven decision-making.	• Poor infrastructure and weak data systems limit AI effectiveness in some regions • Ongoing maintenance and updates are essential but add to long-term costs and complexity
Opportunities	Threatens
• AI can enhance agricultural sustainability by reducing resource use, waste, and emissions, and improving water management, especially in water-scarce regions. • Opportunities exist to design affordable AI solutions for smallholder farmers, boosting productivity and climate adaptation with minimal investment. • AI supports both climate change mitigation (e.g., reducing carbon emissions) and adaptation by helping farmers adjust to changing climate patterns. • Increased government and international interest in climate-smart agriculture provides opportunities for collaboration and funding to expand AI use in farming.	• The high cost and complexity of AI may increase inequality in agriculture, with wealthier farmers gaining an advantage over poorer ones. • AI models struggle with the unpredictability of extreme weather, making it difficult to fully rely on AI-driven predictions. • Increased use of AI and automation may raise environmental concerns, such as higher energy consumption and over-reliance on machines. • The large-scale use of AI in agriculture makes systems vulnerable to cyber attacks, potentially disrupting operations and compromising data privacy.

Source: Compiled by the researcher

4. AI-Agri -Climate Resilience Framework Policy for Governments & Decision-





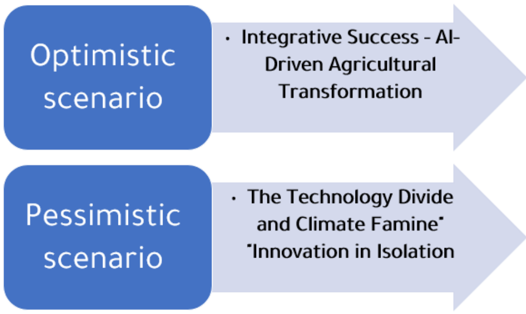
Source: Compiled by the researcher

5. Future scenarios for the battle of artificial intelligence against global hunger and climate change

Key findings

- The Food and Agriculture Organization (FAO) stated in its report on digital agriculture that artificial intelligence can improve food production and resource management in developing regions when infrastructure and international cooperation are available.
- The World Economic Forum (WEF) has warned that AI technologies could create "technological inequality" if monopolized by large companies without technology transfer.
- According to ITU and FAO joint report: International cooperation possible to stimulate low-cost AI tools serving rural areas
- According to IPCC Sixth Assessment Report (AR6): Failure to act together is accelerating the collapse of ecosystems and agriculture, and is leading to the failure of early warning systems.

Based on the trends and drivers identified, two plausible future scenarios emerge for AI's role in tackling the interconnected crises of global food insecurity and climate change:



Source: Compiled by the researcher

- The optimistic scenario (high technological progress + strong international cooperation) reflects strong international cooperation that results in the creation of early warning networks for climate disasters covering poor countries, the global sharing of climate and food data via open-source artificial intelligence platforms, a 40% reduction in food waste, a 25% improvement in crop productivity in Africa and Asia, and a reduction in the global food gap.
- The pessimistic scenario expresses a mixture of tremendous technological progress and the absence of strong

international cooperation, or a mixture of declining technological progress mixed with the absence of international cooperation, ((high technological progress + weak international cooperation) or (weak technological progress + weak international cooperation) resulting in a gap between rich and poor countries, with the global hunger crisis worsening and the rich countries monopolizing it.

Conclusion

The intersection of global hunger and climate change is one of the most prominent challenges facing the world today, especially in light of economic shocks and rising food prices. These factors disrupt food production, which requires innovative solutions to deal with these interconnected crises. The study emphasizes the vital role that artificial intelligence can play in addressing these issues by improving sustainable agriculture, enhancing food security, and enabling farmers to adapt to unexpected environmental conditions.

Artificial intelligence provides opportunities to improve resource use, predict climate impacts on crops, and increase the efficiency of the food supply chain. However, to achieve success in using this technology, governments, private institutions, and international organizations must cooperate to integrate artificial intelligence into the agricultural sector and support small farmers who are the cornerstone of global food production.

Although artificial intelligence is not the only solution to global crises, it can contribute significantly to addressing these challenges through its application in sustainable agriculture and improving the ability to predict global crises. By investing in AI-based solutions, enhancing data partnerships, and paying attention to climate-resilient agricultural practices, significant progress can be made towards ensuring a stable and sustainable food supply for future generations.

Recommendations

1. Investing in Scalable and Accessible AI Infrastructure

- ✓ Decision-makers should prioritize investment in AI infrastructure such as cloud computing, IoT sensors, and satellite systems to support data collection and analysis in agriculture and climate monitoring.
- ✓ Access to high-speed internet and low-cost AI tools should be ensured, especially for small farmers in developing countries.

<u>Action Steps:</u>

- Funding public-private partnerships to deploy IoT and satellite networks in rural areas.
- Providing financial support for AI tools for small farmers to reduce financial barriers.
- Developing open-source models to expand access, as in the Climate-Smart Agriculture pilot in Ethiopia. (Abegaz et al., 2024)

2. Promoting digital literacy and building AI capacity

- ✓ Establish training programs and educational initiatives to enhance understanding of AI among farmers, agricultural extension workers, and policymakers.
- ✓ Focusing on practical skills such as interpreting AI-driven results and using AI tools in decision-making.

Action Steps:

- Collaborating with universities and NGOs to develop training modules tailored to local needs.
- Developing mobile-based training applications to reach farmers in remote areas.

- Promoting knowledge-sharing platforms to disseminate good practices, such as AI-powered agricultural networks in Africa.

3. Encouraging the creation of ethical and inclusive AI systems.

- ✓ Implementing regulatory frameworks to ensure transparency, ethics, and inclusivity in AI systems, including data privacy, algorithmic biases, and equitable access.
- ✓ Prioritizing solutions that address the needs of marginalized groups, including smallholder farmers and women in agriculture.

Action steps:

- Enforcing data privacy regulations aligned with global standards such as the General Data Protection Regulation (GDPR).
- Involving local communities in the design of AI tools to ensure their relevance to local contexts.
- Funding AI projects focused on gender equality.

4. AI And Climate-Smart Agriculture Integration

- ✓ Encouraging the integration of AI with climate-smart agriculture practices, such as precision irrigation, crop diversification, and carbon sequestration.
- ✓ AI can predict climate impacts and improve resource efficiency, as in Australia's experiment to predict wheat yields under heat stress.

Action Steps:

- Supporting AI tools for precision irrigation and soil management, as in India.
- Funding AI research models for carbon sequestration within agroforestry systems.
- Strengthening AI-based early warning systems for climate disasters, as in flood and heatwave forecasting in Ethiopia.

References

Abegaz, D., Teklu, A., & Belay, S. (2024). Climate-smart agriculture in Ethiopia: Opportunities and challenges. *Journal of Agricultural Science, 12*(3), 45-56.

Adams, S. (2033). *How artificial intelligence is helping to fight climate change. Scientific American*. https://www.scientificamerican.com/article/how-artificial-intelligence-is-helping-to-fight-climate-change/

Alain News. (2024). *10 ways artificial intelligence helps tackle climate change*.

Arti. (2021). *Top 7 countries using artificial intelligence to address climate concerns*. Analytics Insight. https://www.analyticsinsight.net/artificial-intelligence/top-7-countries-using-artificial-intelligence-to-address-climate-concerns

Attia, F. (2023). The future of the Egyptian labor market in light of modern technology: A study of the implications of artificial intelligence on the future of jobs in Egypt in light of the Corona pandemic.

Blue Yonder. (n.d.). *AI & machine learning: Make better decisions in less time for real-world impact*. https://blueyonder.com/why-blue-yonder/ai-and-machine-learning

Datategy. (2023, March 7). *Reducing carbon emissions with AI: The role of machine learning in energy efficiency*. https://www.datategy.net/2023/03/07/reducing-carbon-emissions-with-ai-the-role-of-machine-learning-in-energy-efficiency/

Doshi-Velez, F., & Kim, B. (2017). *Towards a rigorous science of interpretable machine learning*. arXiv. https://arxiv.org/abs/1702.08608

EIA ,U.S. Department of Energy. (2021). *Annual energy outlook 2021*. U.S. Energy Information Administration. https://www.eia.gov/outlooks/aeo/

Farm out,(n.d), Revolutionizing American Agriculture: How AI Policy and Innovation Drive Smart Farming in the United States, available at: https://farmonaut.com/usa/ai-driven-smart-farming-transforming-us-agriculture-now

Financial Times,2025, How we can use AI to create a better society.

Food and Agriculture Organization (FAO). (2024). *The state of food security and nutrition in the world 2024: Ending hunger and ensuring food security*. https://openknowledge.fao.org/server/api/core/bitstreams/39dbc6d1-58eb-4aac-bd8a-47a8a2c07c67/content/state-food-security-and-nutrition-2024/ending-hunger-food-security.html#gsc.tab=0

Global Hunger Index. (2024). *2024 Global Hunger Index: The challenge of hidden hunger*. https://www.globalhungerindex.org

Green, E. (2024). *AI and climate change: How the UK is leading the way*.

Gupta, H. (2023). *Machine learning forecasting: How AI is improving weather forecasting*. Climate.ai. https://climate.ai/blog/machine-learning-forecasting-how-ai-is-improving-weather-forecasting/

Hoffmann, M. (2024, March 22). *Germany's AI-powered renewable energy revolution*. Deutsche Welle. https://www.dw.com/en/germanys-ai-powered-renewable-energy-revolution/a-57012345

Hung, S. K.-C., & Siddiqi, Y. (2024). *Cultivating a greener future: How AI can transform agriculture for food security and sustainability*. Asian Development Bank (ADB).

IMARC Group. (2025). *AI in agriculture market size, share, trends and forecast by offering, technology, application, and region, 2025-2033*.

Jobin, A., Ienca, M., & Vayena, E. (2019). The global landscape of AI ethics guidelines. *Nature Machine Intelligence, 1*(9), 389-399. https://doi.org/10.1038/s42256-019-0088-2

Johns Hopkins University. (2023, March 7). How AI can help combat climate change. https://hub.jhu.edu/2023/03/07/artificial-intelligence-combat-climate-change/

MachineFinder. (2024). *John Deere See & Spray led to 59% average herbicide savings in 2024*. https://www.machinefinder.com/ww/en-US/articles/john-deere-see--spray-led-to-59-average-herbicide-savings-in-2024-12860

Masterson, V. (2024). *9 ways AI is helping tackle climate change*. World Economic Forum.

Metych, M. (2025). Global food security. Encyclopedia Britannica. https://www.britannica.com/topic/global-food-security

Ministry of Climate Change and Environment. (2024). *The Agriculture Innovation Mission for Climate*. United Arab Emirates (UAE).

Morning Ag Clips. (2025). *How to use drones for efficient farm management and monitoring*. https://www.morningagclips.com/how-to-use-drones-for-efficient-farm-management-and-monitoring/

NetBeat. (2020). *NetBeat digital farming catalog - June 2020*. https://www.netafim.com/contentassets/782a776f654f42c2ae298160bdf11067/digital-farming-catalog---june-2020-online.pdf

Pangarkar, T. (2025). *AI in agriculture statistics*. Scope Market. https://scoop.market.us/ai-in-agriculture-statistics/

Plantix. (n.d.). *Plantix: Your crop doctor*. https://plantix.net/en/

PwC. (2024). *How AI can enable a sustainable future*.

REN21. (2020). *Renewables 2020 global status report*. https://www.ren21.net/reports/global-status-report/

Singh, A. R. (2023). Artificial intelligence in India's fight against climate change. *Indian Journal of Environmental Research*.

Swissinfo. (2025). *How satellites and AI can help check the pulse of our warming planet*. https://www.swissinfo.ch/eng/climate-change/how-satellites-and-ai-can-help-check-the-pulse-of-our-warming-planet/88767231

Tanaka, Y. (2023). *The role of AI in Japan's climate change mitigation efforts*. Nikkei Asian Review. https://asia.nikkei.com/Spotlight/Environment/The-role-of-AI-in-Japan-s-climate-change-mitigation-efforts

The Gaurdian,2024, High tech, high yields? The Kenyan farmers deploying AI to increase productivity.

The Columbia Climate School. (2018, June 5). *Artificial intelligence—A game changer for climate change and the environment*. Columbia University. https://news.climate.columbia.edu/2018/06/05/artificial-intelligence-climate-environment/

Tractor Junction. (2024). *Artificial intelligence in agriculture - Benefits and challenges in farming*.

United Nations. (2023, November). *Explainer: How AI helps combat climate change*. https://news.un.org/en/story/2023/11/1143187

United Nations. (n.d.). What is climate change? https://www.un.org/en/climatechange/what-is-climate-change

VentureBeat. (2018). *IBM's new AI platform for agriculture predicts crop prices, combats pests and more*. https://venturebeat.com/ai/ibms-new-ai-platform-for-agriculture-predicts-crop-prices-combats-pests-and-more/

Vinuesa, R., Azizpour, H., Leite, I., Balaam, M., Dignum, V., Hoeijmakers, S., & Buyl, S. (2020). The role of artificial intelligence in achieving the Sustainable Development Goals. *Nature Communications, 11*, Article 233. https://doi.org/10.1038/s41467-019-14108-y

World Economic Forum (WEF). (2024, February). *9 ways AI is helping tackle climate change*. https://www.weforum.org/stories/2024/02/ai-combat-climate-change/

Zhang, Bonnie (27 May 2020). "Pinduoduo to hold "Smart Agriculture Competition"". Pandaily. Retrieved 28 January 2022.