

Artificial Intelligence (AI) and food security: growing more food with smarter decisions

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Can artificial intelligence help feed the world?

Food is one of the basic necessities of life. However, ensuring that everyone has enough, safe, and nutritious food is now becoming increasingly difficult. The world's population continues to grow, while climate change, water scarcity, land degradation, pests, and diseases threaten agricultural production. According to global estimates, nearly 10 billion people may live on Earth by 2050, meaning that food production must increase significantly to meet the future demand.

Artificial Intelligence (AI) is emerging as a powerful tool that can help address these challenges. By analyzing large amounts of data and providing useful recommendations, AI can support farmers, food producers, businesses, and governments in making better decisions. From planting seeds to delivering food to consumers, AI is transforming the way the food is produced, distributed, and consumed.

Imagine a farmer receiving a message on a mobile phone warning that a pest attack is likely to occur in a rice field within the next few days. The farmer acts immediately and prevents major crop damage. Now imagine a computer system that can predict rainfall, recommend the best time to irrigate crops, or help reduce food waste during transportation. These are no longer ideas from science fiction, but they are real applications of AI.

Understanding food security

Food security exists when all people have access to sufficient, safe, nutritious, and affordable food at all times. It is built on four important pillars.

The first pillar is food availability, which means enough food must be produced and supplied. The second is food access, meaning people must be able to obtain food physically and economically. The



Figure 1: AI in the food system: from farm to fork
(Source: *Transforming the food industry* | Premium AI-generated image)

third pillar is food utilization, which refers to food quality, nutrition, and safety. The fourth pillar is food stability, ensuring that food remains available even during difficult situations such as droughts, floods, or economic crises.

Many factors can threaten food security. Extreme weather events can destroy crops. Rising temperatures can reduce yields. Poor storage facilities can lead to food spoilage. Transportation delays can prevent food from reaching markets. Food waste also remains a major global issue. AI has the potential to strengthen all four pillars of food security by helping people make faster, smarter, and more informed decisions.

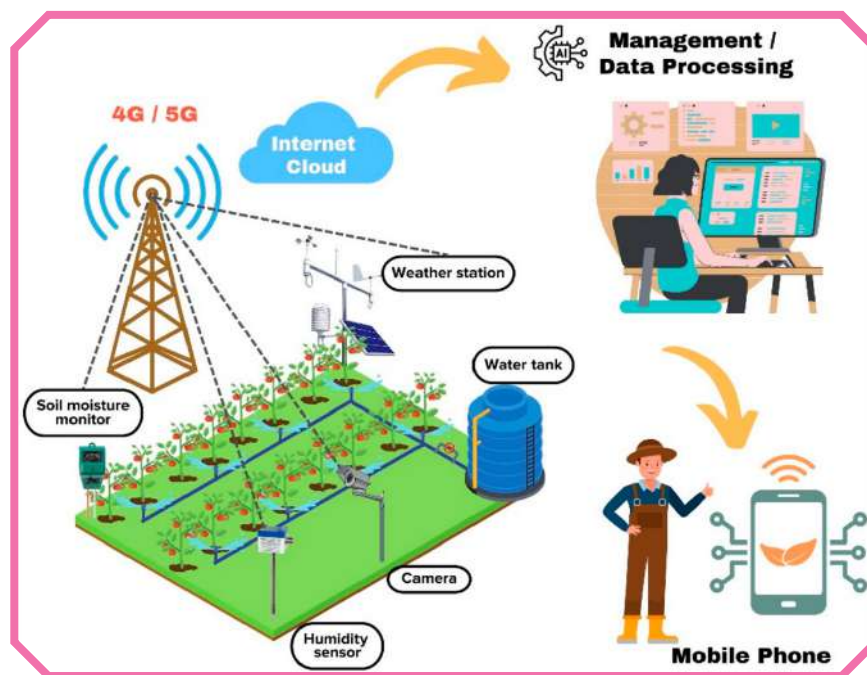


Figure 2: Advanced irrigation hub assisted with real-time weather and moisture sensors and decision support systems.

What is artificial intelligence (AI)?

AI refers to computer systems that can learn from data, recognize patterns, solve problems, and make recommendations. Many people already interact with AI every day through voice assistants, online recommendation systems, navigation applications, and translation tools.

In agriculture, AI works by collecting information from different sources such as satellites, drones, weather stations, cameras, mobile phones, and field sensors. The system then analyzes the data and provides useful insights that help farmers improve productivity and reduce risks.

Instead of replacing farmers, AI acts as a decision-support tool that helps them make better choices.

Smarter farming through precision agriculture

One of the most important applications of AI is the precision agriculture. Precision agriculture involves managing farms based on accurate information rather than guesswork.

Traditionally, farmers often apply water, fertilizer, and pesticides uniformly across entire fields. However, not all areas of a field require the same treatment. Some areas may need more water, while others may require additional nutrients. The AI systems can analyze data from satellites, drones, and field sensors to identify differences within a field. Farmers can then apply resources only where they are needed. For example, sensors placed in the soil

can measure moisture levels. If a certain part of the field becomes dry, the AI system can recommend irrigation only for that area. This reduces water use while maintaining crop productivity. Similarly, AI can estimate future crop yields by analyzing weather patterns, soil conditions, and crop growth data. Farmers can use this information to plan harvesting and marketing activities more effectively. The result is the increased efficiency, lower costs, and improved agricultural productivity.

Detecting plant diseases before they spread

Plant diseases and pest attacks cause billions of dollars in agricultural losses every year. Early detection is, therefore, essential because small problems can quickly become major outbreaks.

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weather conditions. Farmers often face uncertainty due to droughts, floods, storms, and changing rainfall patterns.

The climate change has made weather conditions more unpredictable, creating

farmers to protect equipment, livestock, and harvested crops. The governments and the agricultural agencies can also use the AI-powered forecasting systems to develop disaster preparedness plans and strengthen national food security.

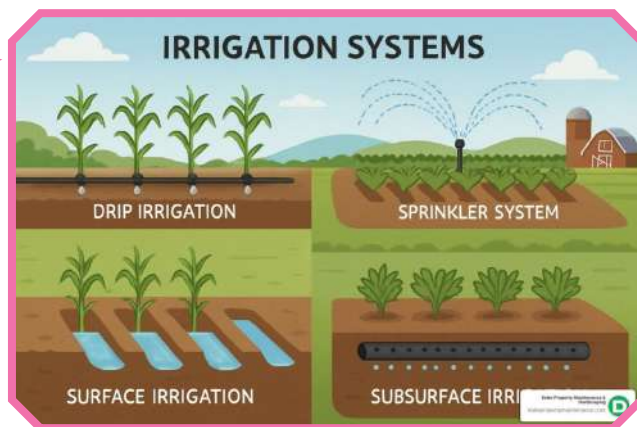
Saving water through smart irrigation

The AI-powered image recognition systems can help farmers identify diseases at an early stage. A farmer can simply take a photograph of a suspicious leaf using a Smartphone. The AI system compares the image with thousands of examples stored in its database and suggests possible diseases or nutrient deficiencies.

For instance, if a rice leaf shows unusual spots, the system may identify the disease and recommend appropriate control measures. This allows farmers to respond quickly before the problem spreads throughout the field. Early disease detection can reduce crop losses, decrease pesticide use, and improve overall crop health. Such technologies are becoming increasingly accessible through mobile applications, making them useful even for smallholder farmers.

Using AI to predict weather and climate risks

Agriculture depends heavily on



new challenges for food production.

AI can analyze historical weather records, satellite data, and climate information to generate forecasts and predictions. These predictions help farmers prepare for potential risks.

For example, if an AI system predicts a prolonged dry period, farmers can adjust irrigation schedules or choose drought-resistant crop varieties. Similarly, early flood warnings allow

Water is one of the most valuable resources in agriculture. Unfortunately, traditional irrigation methods often result in significant water losses. Smart irrigation systems combine sensors, weather forecasts, and AI algorithms to determine when and how much water is required

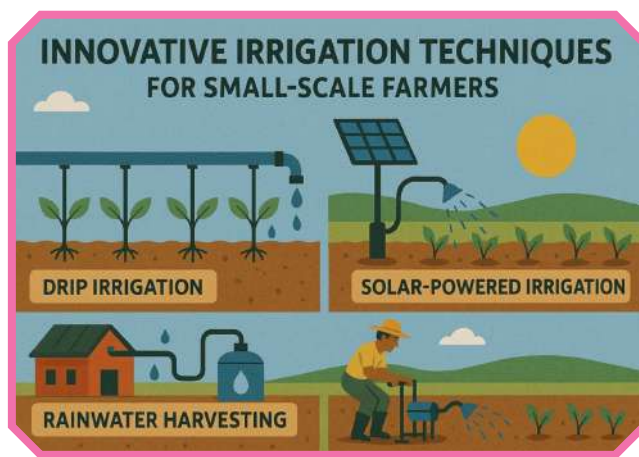


Figure 3: Evolution of traditional irrigation to smart innovative irrigation systems
(Source: *Traditional Irrigation Types*)

by crops. Instead of following fixed irrigation schedules, these systems respond to real-time field conditions. Water is applied only when necessary, reducing waste and improving the efficiency. This approach is particularly valuable

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in regions affected by water scarcity. By conserving water while maintaining crop yields, smart irrigation contributes to both food security and environmental sustainability.

Robots, drones, and the future farms

Modern farms are increasingly adopting advanced technologies such as drones, robots, and autonomous machinery.

Drones can capture high-resolution images of fields, monitor crop growth, identify problem areas, and even apply pesticides with precision. This allows farmers

worldwide. Future farms may combine AI, robotics, and automation to increase productivity while reducing environmental impacts.

AI beyond the farm for improving the food supply chain

Food security is not only about growing food. It also involves transporting, storing, processing, and delivering the food efficiently. Large quantities of food are lost after harvesting due to poor storage conditions, transportation delays, and inefficient supply chains.

AI can improve logistics by predicting demand, optimizing

for food preservation. These improvements help ensure that food reaches the consumers safely and efficiently.

Reducing food waste

Globally, a significant portion of the food produced never reaches consumers. Food waste occurs during production, transportation, storage, retailing, and household consumption. AI can help to address this problem in several ways. Retailers can use the AI systems to predict consumer demand more accurately and avoid ordering excessive quantities of food. Restaurants can analyze customer preferences and reduce unnecessary food preparation. Smart refrigerators can even remind consumers when the food products are approaching their expiration dates. Reducing the food waste not only improves food availability but also decreases the environmental impacts associated with food production.



Figure 4: Use of drones in agriculture

(Source: DJI Agriculture Drones: The Future of Sustainable Farming - I)

to cover large areas quickly and efficiently. Autonomous tractors can perform planting and field operations with minimal human intervention. Harvesting robots are being developed to pick fruits and vegetables accurately while reducing labor requirements. Although these technologies are currently more common in the developed countries, the costs involved are gradually decreasing, making them more accessible

transportation routes, and monitoring storage conditions. For example, the AI systems can analyze market trends and estimate how much food consumers are likely to purchase. Retailers can then adjust their inventory accordingly, reducing the waste caused by overstocking. Temperature sensors connected to the AI systems can monitor storage facilities and alert managers, if conditions become unsuitable



Figure 5: Post-harvest losses of agricultural produce

Supporting smallholder farmers

Smallholder farmers produce a large share of the world's food, especially in developing

countries. However, they often face challenges such as limited access to information, technology, and financial resources. The AI-powered mobile applications can provide farmers with weather forecasts, pest alerts, market prices, and crop management advice directly through the Smartphone. For example, a farmer can receive a warning about an upcoming pest outbreak or learn where to obtain the best market price for a crop. Such information helps farmers to improve productivity and increase the income. As Smartphone ownership continues to grow, the AI-based advisory services have the potential to benefit millions of smallholder farmers around the world.

Challenges that must be overcome

Despite its many advantages, AI is not a complete solution to food security challenges. One major challenge is the cost of technology. Advanced sensors, drones, and automated equipment can be expensive; particularly for the small-scale farmers. Another challenge is the access to reliable Internet connectivity and digital infrastructure. Many rural communities still have limited access to digital services. Training is also important. Farmers

need support to understand and effectively use the AI-powered tools. There are also concerns about data privacy and ownership. Farmers should have confidence that information collected from their farms will be used responsibly. Addressing these challenges will require investments in infrastructure, education, and supportive policies.

The future of AI and food security

The future of AI in agriculture is promising. Emerging technologies such as the Internet of Things (IoT), advanced robotics, digital twins, and satellite monitoring are expected to further improve farming efficiency and sustainability. Researchers are also developing AI systems that can provide personalized recommendations for individual farms. Future technologies may help farmers adapt more effectively to climate change while conserving natural resources. As these innovations become more affordable and widely available, they could play a significant role in strengthening global food security.

Food security remains one of humanity's greatest challenges. Ensuring that everyone has access to sufficient, safe, and nutritious

food requires innovative solutions that increase productivity while protecting the environment. AI offers powerful tools for achieving these goals. From precision farming and disease detection to smart irrigation, climate forecasting, and food waste reduction, AI is helping transform food systems around the world. However, technology alone cannot solve food insecurity. Success will depend on collaboration among farmers, scientists, governments, businesses, and communities. By combining human knowledge with intelligent technologies, the society can build more resilient, sustainable, and efficient food systems for future generations. The future of food security may well depend on how wisely we use Artificial Intelligence today.



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