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# Artificial Intelligence: New Definition of Modern Agriculture

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**SUMMARY**

Throughout pre-history, machinery evolved from using rocks to sharpen stone tools to using iron tools for various purposes. The world population is rising at an alarming rate and by 2050 the world population will reach 9.1 billion (FAO, 2014), 34 percent higher than today's population. To feed this large population, food production must increase by about 70 percent more than it is today. Therefore, the traditional procedures are insufficient to meet this need. Farmers and agro-businesses are being pushed to find innovative ways to improve output while reducing waste. As a result, Artificial Intelligence (AI) is becoming an increasingly relevant aspect of the agricultural industry's technological progress to feed an additional two billion people by 2050, to boost global food output by 50%. AI-powered solutions will not only help farmers to enhance efficiency, but will also help them to increase crop yield, quality, and time to market.

## INTRODUCTION

Agriculture may be the oldest profession, but with the prospect of food insecurity looming, its importance has only grown. The Green Revolution improved crop production by nearly 80 percent simply by increasing arable land by 20 percent, but the rate of growth is declining over the years from 3.1 percent in 1960 to 1.5 percent in 2000. Artificial intelligence-powered technology is ensuring the long-term viability of high-quality agricultural production. Artificial intelligence is being used to detect pests, anticipate the optimal time to sow and calculate the price of produce. Drones, Hydroponics, Automated lighting and AI-powered cameras are all being used to keep wild animals away from crops. The agriculture industry is turning to artificial intelligence (AI) to solve the dual problem of food shortages and food waste caused by locust swarms, climate change, droughts, and floods. Agriculture is following in the footsteps of AI solutions that have permeated every part of our lives, from music discovery and restaurant recommendations to banking and fitness.

### Artificial Intelligence in Agriculture (How AI can be used in Agriculture)

Information processing power, in specific, is anticipated and becomes the most disruptive technology in agriculture activities because of its ability to understand, learn, and responds to various circumstances. AI machines have great potential in agriculture to provide farmers with information on soil quality, when to plant the seeds, where and how to spray herbicides, or when to expect pest infestations. As a result, if AI systems can advise farmers on best practices, India may witness a farming revolution. However, scaling up to serve the entire value chain with factors like capacity expansion and cost reduction in mind is a formidable challenge in such a futuristic scenario.

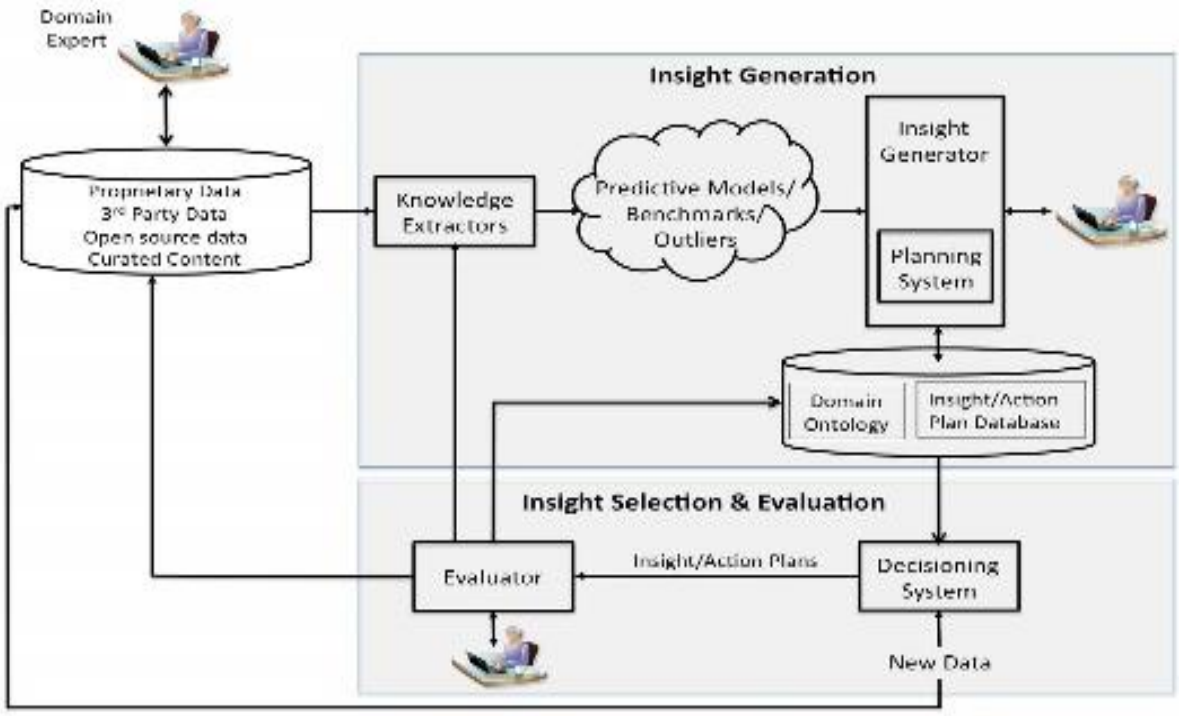
### Crop Growth

IoT Collects and analyses massive amounts of data every day, both structured and unstructured (internet of things). These include information such as historical weather patterns, soil reports, updated research, rainfall, pest infestation, and images captured by drones and cameras, among other things. All of this data can be sensed by cognitive IoT solutions, which can then provide actionable insights to increase yield.

### Testing of Soil

Proximity and Remote Sensing are two technologies that facilitate intelligent data fusion. Soil Testing is one application of this high-resolution data. While remote sensing necessitates the integration of sensors into airborne or satellite systems, proximity sensing necessitates sensors that are in direct contact with the ground or at a very close range. This aids in the classification of soils based on the soil beneath the surface in a specific location.

**Image-based Insight Generation**




Drone-based images can be useful for in-depth field analysis, crop monitoring, field scanning, and other tasks. They can be used in conjunction with computer vision technology and the Internet of Things to help farmers take quick decisions. These feeds can provide farmers with real-time weather alerts.

**Disease Detection and Diagnosis**

Computer Vision Technology is used to capture images of various crops under white and/or UV light. Farmers can then sort the produce into stacks before delivering it to the market. The foliar images are segmented into areas for further diagnosis after pre-processing. A technique like this would allow pests to be identified more clearly.

**Agri Product Marketing**

Cognitive computing makes recommendations to farmers on the most efficient choice of crops and seeds. This is based on multiple variables such as soil conditions, weather forecast, type of seeds, and infestation around a particular location. The advice in this instance focuses on the farm's needs, local conditions, and previous successes. Artificial intelligence can also consider a wide range of factors such as market trends, prices, and consumer needs.

**Spraying of Pesticides and Herbicides**

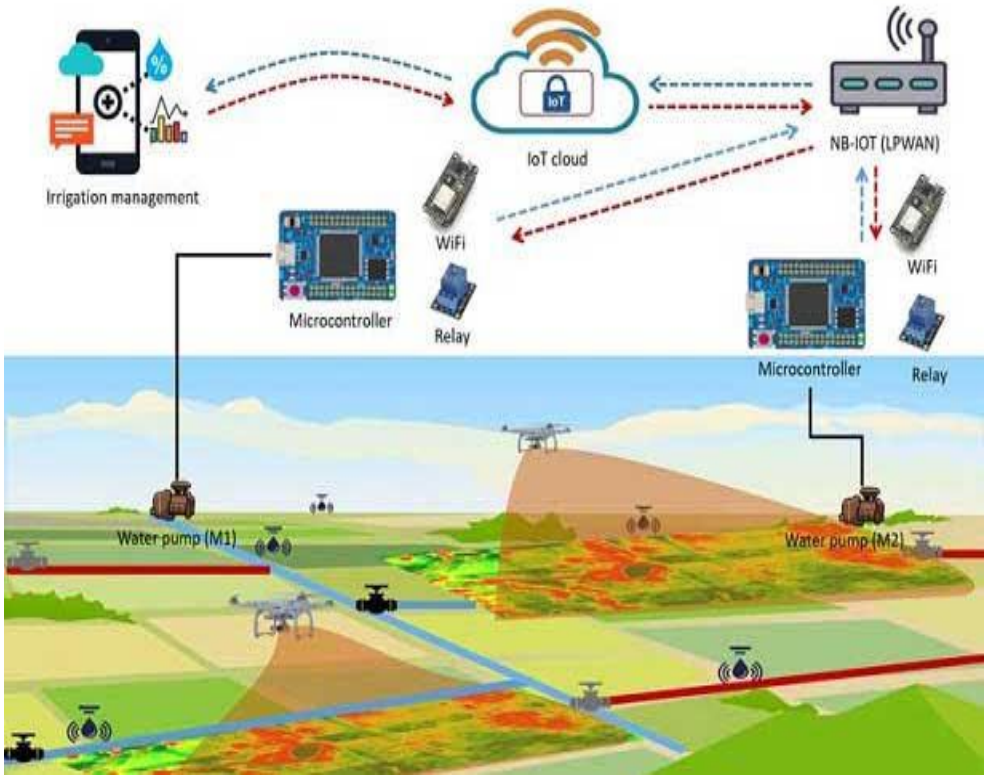
A weed detection and targeting AI system can help to determine the proper herbicide to use in a specific area. This minimizes the need for herbicides and saves money. Many technology firms have created robots that are using computer vision and artificial intelligence to monitor and precisely spray weeds. These robots are capable of eliminating 80 percent of the volume of chemical compounds normally sprayed on crops and limiting herbicide expenditure by 90 percent. These can drastically reduce the number of chemicals used in the fields, improving the quality of agricultural produce while also reducing costs.

**Tackling the Labours Shortage**

Robotic machines capable of bulk harvesting with greater accuracy and speed are responsible for supplying products to your kitchen table. These machines increase yields and reduce waste from crops remaining in the field.

**Application of Artificial Intelligence (AI) in Agriculture**

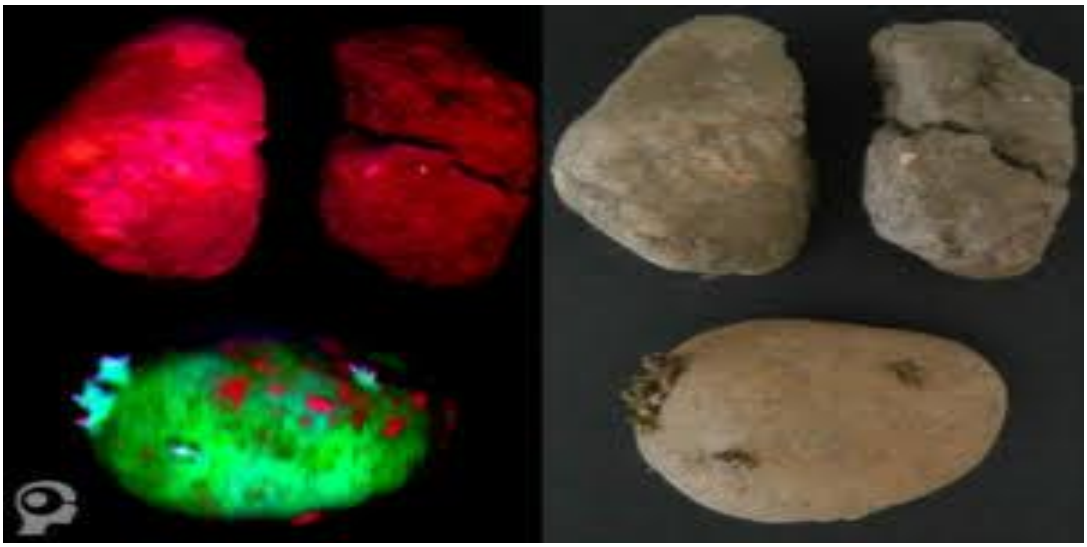
**Automated Irrigation System**




Agriculture irrigation systems can be monitored using a Smartphone or Laptop. The device is connected with sensors that collect data like moisture level, crop status, temperature, RH, soil status, etc. and transmit that data to the farm irrigation system. As soon as the deficiency is predicted the device sends the alert and the water

sprinkler is turned on. This helps to facilitate irrigation scheduling and improve water use efficiency. The system also notifies the farmer when watering commences and ends and sends error alerts. If there is a technical issue, the system should be able to detect abnormalities in the irrigation flow and immediately alert the farmer.

**TADD (Trainable Anomaly Detection and Diagnosis) System**



Sorting potatoes is challenging and time-consuming. The Trainable Anomaly Detection and Diagnosis System can detect, identify, and quantify many of the common blemishes affecting potatoes (Pang *et al*., 2021). TADD is currently only a vision system, but even spotting an off-color spud is more difficult than it appears. When potatoes are exposed to too much light, they turn green, but the greening of red potato varieties appears black.

**Drones for Spraying**

The device is far superior to manual spraying because it is much faster and ensures uniform pesticide spraying across the entire crop. As drones do not contact the soil, they can help to avoid crop damage caused by compaction.

**Remote Sensing-based Crop Health Monitoring**

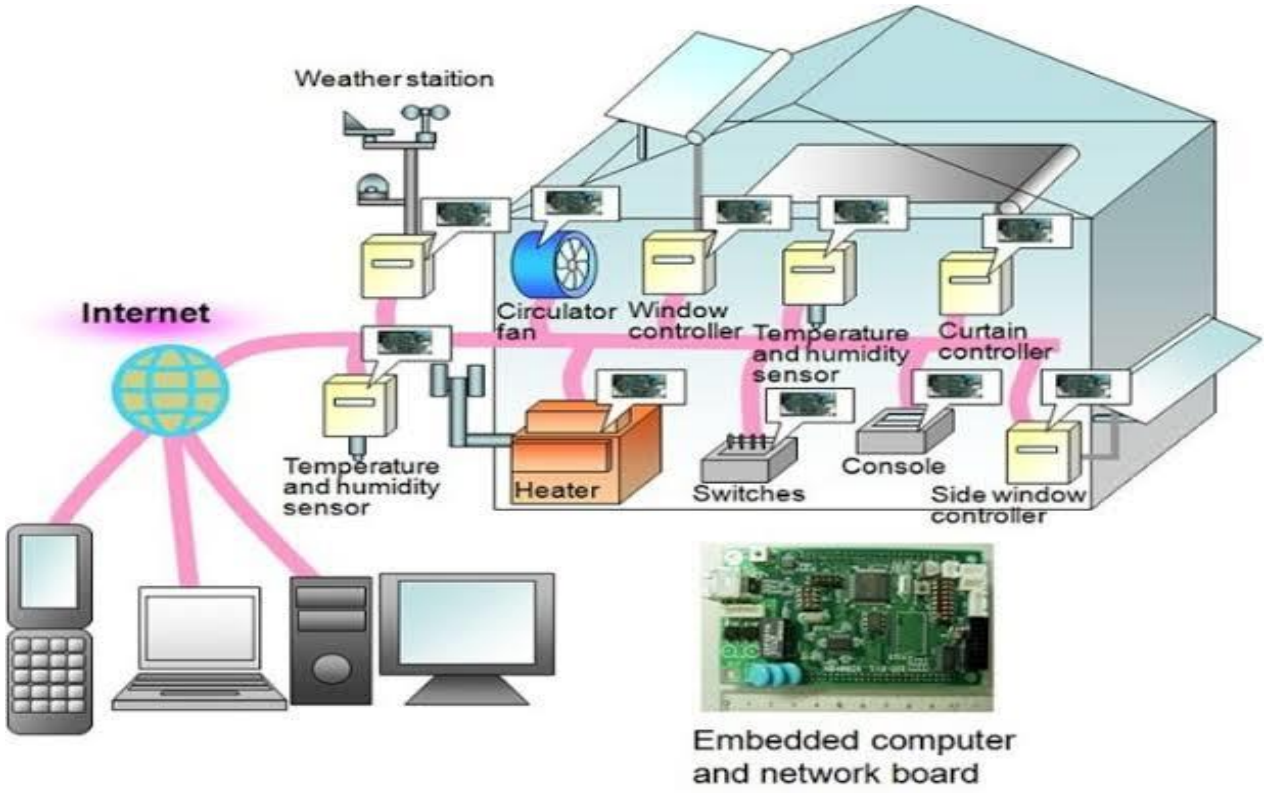
Remote sensing provides a tremendous opportunity to obtain a global synoptic view of the world organization. Since satellite data, numerous classes of selective information on available resources, such as soil humidity, soil use, and cover, crop natures and states, and soil type data, can be mined. In the future, remote sensing will provide frequent and low-cost information to allow, at the appropriate time, interference to aid in crop state recovery. Satellite structures provide permanent spatial and temporal records of the entire globe. Remote sensing indices derived from satellite imagery, such as the Normalized Difference Vegetation Index (NDVI), Land Surface Water Index (LSWI), Temperature Vegetation Dryness Index (TVDI), Soil Adjusted Vegetation Index (SAVI), Water Deficit Index (WDI), and others, are useful in determining crop development and/or soil humidity state (Wu *et al*., 2014).

**Decision Support System for Greenhouse Tomato Production**

The key parameters that affect the quality and quantity of tomatoes in the greenhouse are temperature and $CO_2$. Studies have shown that warm temperatures at night improve tomato yield. The developed systems take into

account various growing conditions and plant development factors. Air temperature (day and night), fruit temperature, radiation, $CO_2$ concentration, fruit load, plant density, stress, and other environmental factors all have an impact on tomato plant growth and productivity. A decision support system adjusts the temperature dynamically during the ripening process to improve yield.

**Greenhouse Based Climate Controller with AI-based Techniques**

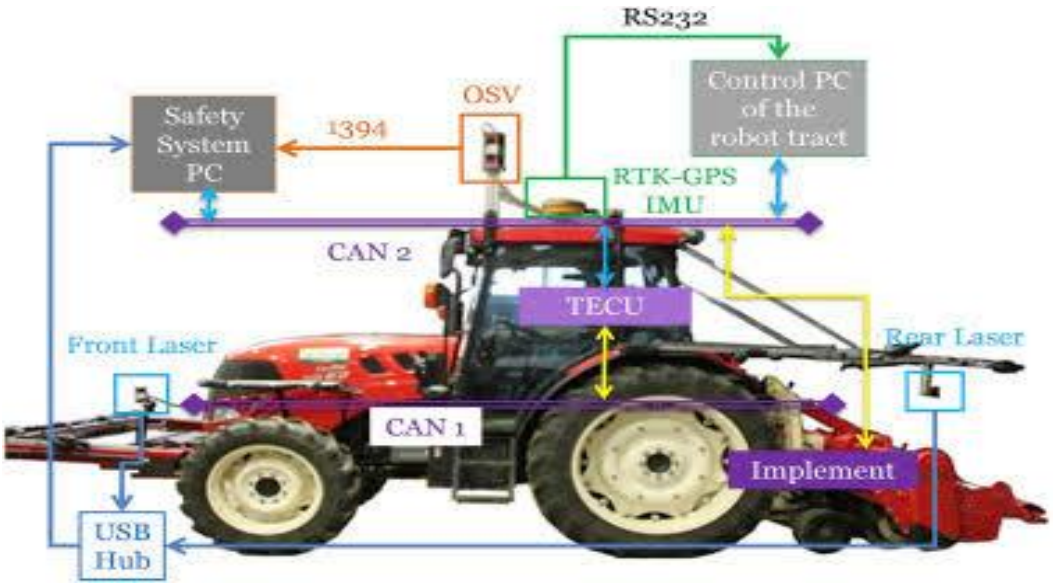



A greenhouse shields the crop from environmental factors such as rain, wind, cold temperatures, and pests. To create a favorable growing climate, a modern high-tech greenhouse is outfitted with active control of actuators (e.g., heating, lighting, irrigation). Of course, this comes at the expense of increased resource consumption (e.g., fuel, electricity, water). A grower decides on a climate and irrigation strategy and establishes the set points for all climate and irrigation parameters. Actuators are controlled by set points, and sensors provide feedback on measured data to the control loop. Algorithms for automated greenhouse climate control have already been developed for decades. Today's high-tech greenhouses are outfitted with process computers that can control greenhouse actuators based on set points that the grower manually sets.

**GIGAS (Guelph Intelligent Greenhouse Automated System**)

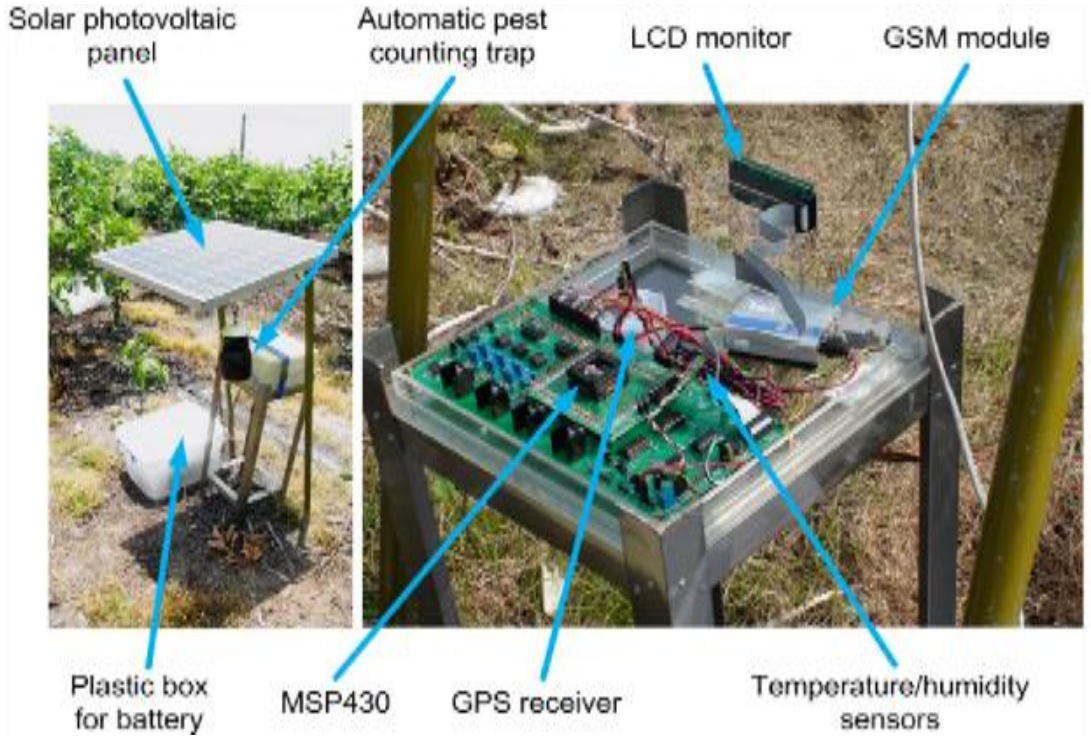
The robotic arm was equipped with visioning technology that allowed it to identify ripe produce. It also had a special gripper that allowed it to pluck fruit from vines without damaging it. The robot can detect symptoms that humans cannot yet see (Moussa and Abdullah, 2012). However, it can scout constantly, whereas a grower may only visit every spot in a greenhouse once every week or two. While patrolling the greenhouse, the robot collects data and assesses whether a plant is growing well or getting enough water, for example. This is information that the grower can then use to optimize growing conditions at the plant level rather than the more traditional canopy level approach.

**Automated Tractor**




The tractors are coupled with some sensors, radar, and GIS systems and can be controlled through a controlling device. It can be used for tillage operations as well as for a few other operations in agriculture. With its automated capabilities, it is both efficient in precision agriculture and meets one of the challenges around labour shortages.

**Autonomous Early Warning System for Fruit Fly**



Artificial Intelligence (AI) has been used in a new system to monitor the oriental fruit fly (*Bactrocera dorsalis*). To predict impending outbreaks, the system employs infrared beams to detect the number of flies in the area.

## CONCLUSION

Is it possible for artificial intelligence (AI) to replace farmers' traditional knowledge? Initially, AI is unlikely to challenge or improve agricultural practices, but in the near future, it may supplement decisions made by farmers. As a result of such technological interventions, farmers' lives are likely to improve qualitatively as well as quantitatively. Artificial intelligence helps alleviate labour and resource shortages to a great extent. This tool will be very useful in assisting organizations in dealing with the increasing complexity of modern agriculture.

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