Harper Adams University

Proceedings of the 5th Symposium on Agri-Tech Economics for Sustainable Futures

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Global Institute for Agri-Tech Economics,

Food, Land and Agribusiness Management Department,

Harper Adams University

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The role of Artificial Intelligence (AI) in agriculture and its impact on economy

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Abstract

In terms of the economy, agriculture plays a significant role. In agriculture, automation has become a major concern and a hot topic around the world. Food and employment demand are rising as a result of a rapidly expanding population. Using the new methods, billions of people were able to meet their dietary needs while also gaining employment opportunities. Farming has undergone an enormous change thanks to artificial intelligence. Crop yields have been protected by this technology from a variety of threats, including climate change, population growth, labour shortages, and concerns about global food security. Weeding, spraying, and irrigation are just a few of the many uses for artificial intelligence in agriculture that this paper examines in detail, with the help of sensors and other tools built into machine and drones. Water, pesticide, herbicide, and soil fertility use, as well as labour use, are all reduced thanks to these new technologies, which boost output while also improving product quality. Robots and drones are being used for weeding in agriculture, and this paper compiles the findings of numerous researchers to give readers an overview of the current state of automation in agriculture. Soil water sensing techniques and two automated weeding methods are discussed. It is discussed in this paper how drones can be used for spraying and crop monitoring, as well as the various methods they can employ.

Keywords

artificial intelligence, agriculture, economy, technological farming, rural areas

Presenter Profiles

An Associate Professor in Warsaw School of Economics, Poland. She deals with the issues of sustainable development in a very broad sense. In the area of her research interests there is both sustainable development in the field of renewable energy and issues in the area of finances, including finance technology, in which innovative financial tools - in the strict sense, i.e. cryptocurrencies and in the broad sense, i.e. to influence a number of economy sectors, i.e. agriculture, industry, services. She is giving lectures at different University all over the World- University of Santiago de Compostela (Spain), University of Alicante (Spain), University del Pacifico in Lima (Peru), Strathmore University in Nairobii (Kenya).

AI's impact on farming

There is a wide range of applications for AI-based technology in all industries, including agriculture, which covers crop production and irrigation as well as soil content and crop monitoring. Agricultural robots are a high-value use of AI in the aforementioned field. AI has the ability to give a much-needed solution to the agriculture dilemma, which is exacerbated by the rising global population (Abdullahi and Sheriff, 2015). An increase in the amount of output and the quality of the product has been achieved thanks to AI-based technology, which has led to a speedier time to market. Farmers will utilize 75 million linked devices in 2020. Approximately 4.1 million data points will be generated by an average farm per day by 2050, according to forecasts. Robots and artificial intelligence (AI) have made a variety of contributions to farming, including:

Recognizing and perceiving images

In recent years, interest in autonomous unmanned aerial vehicles (UAVs) and its applications, such as recognition and surveillance, human body detection and geolocation, search and rescue, and forest fire detection, has increased. Aerial drones, also known as unmanned aerial vehicles (UAVs), are growing in popularity due to their numerous applications and impressive imaging capabilities, which include everything from delivery to photography. They can be controlled via a remote controller, and their dexterity in the air makes them ideal for a wide range of tasks.

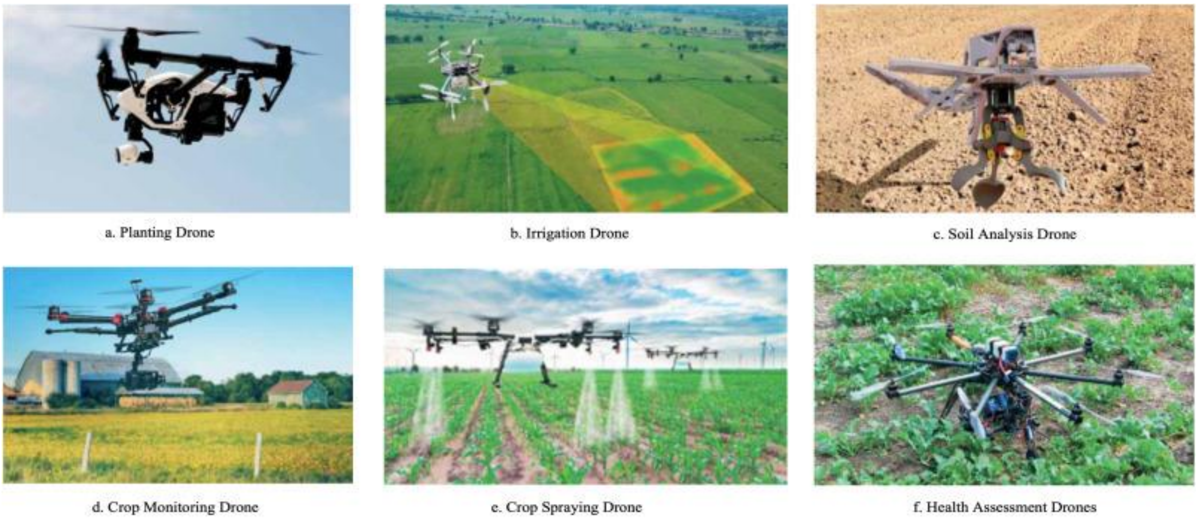

Figure 1: Artificial intelligence role in agriculture. Source: Ahirwar et al. (2019).

Human capital and skills

Many unclear concerns, as well as a wiser irrigation system, may be solved with the help of artificial intelligence, which gathers data from government and public websites, analyses it, and provides farmers with solutions. It is likely that farming in the near future will combine technical and biological talents, resulting in greater quality for all farmers as well as reduced losses and workloads thanks to AI. Approximately two-thirds of humanity will be residing in urban areas by the year 2050, making it imperative that farmers be relieved of their current duties. The use of artificial intelligence (AI) in agriculture can result in automated operations, decreased risks, and easier and more effective farming.

Maximize the amount of work done

Plant performance peaks are determined by the types of seeds used and the quality of the seeds themselves. Crop selection and improved hybrid seed options have been made possible by new technology. Because of the information acquired, plant diseases may be less common. Market trends, annual results, and consumer demands can all be taken into account by farmers to increase crop returns to the highest possible level (Aitkenhead et al., 2003).

Farmer-friendly chatbots

They're just conversational virtual assistants that handle customer service tasks. Farmers have used the AI facility to assist them in receiving answers to their unanswered questions, to give advice and to provide various recommendations. These facilities are primarily for retail, travel or media (Albaji et al., 2010).

Farming with robots

Agri-Food is one of the many industries that will benefit from the introduction of Robotics and Autonomous Systems (RAS). From primary farming to retail, the UK Agri-Food chain generates more than £108 billion a year and employs more than 3.7 million people in a truly global industry that generated £20 billion in exports in 2016. Agricultural production and management have benefited greatly from robotics. A lack of efficiency in conventional farming machinery has prompted researchers to focus on the development of autonomous agricultural tools. On both small and large-scale productions, this technology has proven to be an effective replacement for human labour. Robotics have had a huge impact on productivity in this industry.

Figure 2: Farming through AI machinery. Source: Anand et al. (2015).

Wetlands and irrigation systems

The agriculture sector consumes over 85% of the world's freshwater supply. Moreover, as the global population expands and food consumption rises, this percentage will continue to rise at an even higher rate. As a result, better irrigation methods are required in order to make optimum use of water. Automated irrigation scheduling methods have replaced manual irrigation based on soil water measurements. The evapotranspiration of plants is affected by a range of environmental elements, such as wind speed, sun radiation, and even crop parameters, such as plant density or the presence of a pest, and an autonomous irrigation system was developed to account for this.

The technique of smart irrigation has been created to boost production without the need for large numbers of people by monitoring water levels, soil temperature, nutrient content, and projections of weather conditions. The irrigation pump is controlled by a microprocessor. In agriculture, M2M technology, or "machine-to-machine" technology, has been created in order to facilitate communication and data sharing between and among all of the nodes of the agricultural field through a central network. An automatic robotic model was developed to measure the humidity and temperature of the gadgets in use. At regular intervals, the Arduino's microcontroller (which is coupled to edge-level hardware) processes analogue data and converts it to digital. When the Raspberry Pi 3 gets a signal, which is pre-loaded with the KNN algorithm, it transmits it to the Arduino. It will also be used to update and store sensor data, in addition to providing water (Arvind et al., 2017). Arduino-based irrigation systems have also been developed to save time and effort in irrigating crops. Sensors use a number of technologies to figure out how much moisture is in the soil. It is tucked away among the roots of the plants. For irrigation, the moisture content of the soil is measured using the sensors and the data is sent to the controller. Soil moisture sensors can also considerably reduce water use. It's possible to set a threshold depending on the soil's field capacity and use moisture sensors to water only when needed. When the timer goes off as scheduled, sensors assess the zone's moisture content and only enable watering if it falls below a predetermined threshold. Suspended cycle irrigation, on the other hand, necessitates a longer irrigation period than water-on-demand. There must be a start and end date for each zone.

Irrigation robots cannot function properly without sensors. Irrigation may be controlled in several fields with a single sensor. You can also set up numerous sensors to water different parts of the property. In the first situation where one sensor is used for irrigating different zones, the sensor is placed in the driest section of the field to ensure enough irrigation. Root zone sensors are the best spot to put them, because that's exactly where the plants acquire all their water and nutrients (and there should be no air gaps around the sensors). This will help to ensure that the crops receive adequate amounts of moisture (Bak and Jakobsen, 2004). Later, the SMS controller and sensor must be linked. It is only when the sensor detects movement that the control system takes over. Afterward, the soil water threshold has to be determined. A day of watering is required to soak the sensor once it has been buried. A timed irrigation sensor is configured to operate when the water level reaches a specified level, as previously stated.

Weeding:

Thomas K. Pavlychenko, an early pioneer of weed science in the United States, check out "A History of Weed Science in the United States." After conducting extensive research, he found that weeds were the strongest competitors for water because their roots in the soil overlap to collect water and nutrients. In order to create a pound of dry matter, a plant need the same amount of water as its aerial components. Three times as much water is needed to mature ragweed (Ambrosia artemisiifol ia) as corn or wild mustard (Brassica kaber var. pinnatifida). The dry matter output per acre of a plant is divided by the water need of the plant to arrive at the acre's total water requirement. Light is also essential to plant growth. It is common for tall weeds to block sunlight from reaching nearby plants. For shade-tolerant plants, consider Arkansas rose or field bindweed (also known as milkweed spuroe) (also known as common milkweed spotted spuroe). Over $11 billion in annual agricultural productivity is stolen from India by weeds, according to a report by the Indian Council for Agricultural Research (ICAR). In addition to taking up valuable growing area, these weeds can impair the health of other crops if they aren't eradicated (Bakker et al., 2006).

It was built and created using heredity calculation for weed detection using Hue-Saturation-Intensity shading space for weed detection in open air fields (GAHSI). These mosaicked settings allowed us to determine whether or not GAHSI could be utilised to locate shade space locations or zones when these two borders are exhibited at the same time. This group's appearance following the GAHSI was proof of the location's existence and detachability. We were able to estimate the GAHSI execution by comparing the GAHSI-portioned image to a hand-sectioned reference image. The GAHSI was on par with it in this way.

An automated weed management system must first discriminate between crops and weeds in order to be effective. A method was used to tell carrot seedlings apart from ryegrass seedlings. Leaf morphology is used. With a success rate ranging from 52% to 75%, leaf size variation can be utilized to identify plants from weeds. A novel way of weeding was introduced using digital photography. This concept was implemented using a self-organizing neural network. NN-based technology was found to already exist, allowing for the accurate detection of 75% of the changes between species, however this method failed to produce the appropriate results required for commercial use (Bendig and Bareth, 2012).

A chemical-based

Herbicides must be sprayed on specific areas, and those areas are defined by the first two conditions listed above. There are some areas that do not require spraying because they have a low number of weeds. Weeding requires this step. To get rid of weeds, you don't need to spray every part of the weeds, but you do need to spray enough areas so that the weeds are absorbed by other parts and ultimately destroyed. However, if the sprayed areas are too small, the weeds may not be destroyed, so it's important to be cautious.

Pulse high voltage discharge (PHD)

Non-chemical weeding methods are becoming increasingly popular as environmental and economic concerns about the use of chemicals grow. Non-chemical weed management has also seen a rise in popularity as a result of the growing interest in organic farming. Mechanical, electrical, and biological weed control methods have been studied. In the United States, pulse high voltage discharge (PHVD) is a popular non-chemical weed management approach. It only takes one 15-kV spark to eliminate these tiny weeds (their stems are about 2 mm in diameter and they stand about 5 cm tall). It is possible to eliminate large weeds with a 20 Hz charge (their diameter is 10–15 mm and their height is 80–120 cm). As a result of the spark charges, the movement of waiters to various locations is disrupted. A few days after the spark, the weeds begin to wilt. Rather than using nozzles, spark discharging devices are used in place of the chemicals in this method. The technology is set up to only apply the spark to regions where weeds are detected. Once weed sites have been discovered, the system for spark discharge selects weed points, which represent weed locations. This method, like the previous chemical method, has some conditions that must be met. The following are the conditions:

- Pixel coordinates in images are averaged and this is used to determine the centre of the region.
- This is where the weeding spark discharge is applied.
- A weed is considered destroyed if it receives the spark discharge.
- Weed destruction potential is determined by establishing the first two conditions and then determining where to discharge spars in the fields.

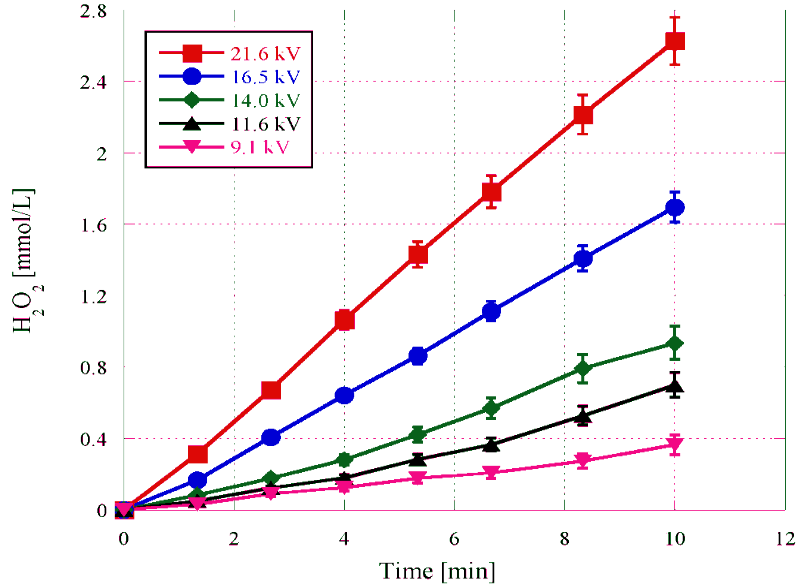

Figure 3: Role of pulse high voltage discharge in AI agriculture. Source: Talaviya et al. (2020).

The use of unmanned aerial vehicles in agriculture

Images captured and processed by UAVs are having a major impact on agriculture thanks to remote sensing techniques. It appears that the rural business has enthusiastically embraced ramble innovation, and is using these propelled instruments to change current agricultural practices. An ongoing PwC study estimates that automation-fueled arrangements in all relevant industries could be worth over USD 127 billion. These sensors are comparable to a standard camera in that they capture clear images, but a multispectral sensor expands the procedure's usefulness by allowing farmers to see things that are not visible in the visible range, such as soil moisture content and plant health monitoring. These might be useful in overcoming the various obstacles that agrarian production faces. Wireless Sensor Networks (WSNs) are used to develop the UAS (WSN). As a result of the WSN's data, Synthetic substances sprayed by the UAS can be more precisely targeted thanks to the UAS's precision spraying capabilities. Due to the frequent changes in ecological conditions, it is almost probable that the control circle must respond as quickly as feasible. The rapprochement of the WSN could be a positive development. Uses in precision agriculture include soil and field analyses, crop height calculations, pesticide application, and more. As long as you stick to the most crucial features like weight, range, payload, and configuration you may be more flexible with your hardware implementations. In a research project, the use of unmanned aerial vehicles (UAVs) is explored, as well as its advantages and disadvantages. More than 250 UAV models are studied and summarized in order to find the best one for agriculture (Bhaskaranand and Gibson, 2011).

Spraying crops

As a result of sensor and microcontroller developments, the travel of unmanned aerial vehicles and their autonomous behaviour are facilitated by UAVS. This isn't a new phenomenon; farmers have been using drones to spray crops for a long time, and they've proven to be extremely effective in foggy weather and in fields with tall crops, such as maize. A major advantage over high-resolution satellite airborne sensors is widely acknowledged as well. In 1987, a microcomputer-based control framework was retrofitted onto an air-carrier plantation sprayer by Giles et al. Ultrasonic range transducers were used to estimate foliage volume, and the sprayer's 3-nozzle manifolds on either side were regulated by control calculations depending on the amount of spray deposited. Using drones to spray synthetic compounds on crops, a control circle was formed with the use of drones in horticulture. These drones administered synthetic substances to the crops in the field under the guidance of remote sensor networks. Drones were only allowed to spray synthetic compounds in specific regions with the help of remote sensors (Birrell and Borgelt, 1996). It was possible to create an autonomous helicopter sprayer with a small spraying capacity. A helicopter with a maximum payload capacity of 22.7 kg and a rotor diameter of 3 m was employed in this study. There was a 45-minute use of one gallon of gas. This technology and its systematic results can be used to develop UAV flying application frameworks with larger VMD droplet sizes and higher target rates.

An energy sprayer that uses hydraulics

The Hydraulic Energy Sprayer can pressurize the sprayed substance using either one of two processes. It is possible to see the gaseous tension above the shower material by using either a positive uprooting syphon or a vacuum device. This pressurized fluid is released through the splash spout. The syphon is responsible for supplying energy to move the material to the plant. Water is the source of power. There is an overwhelming majority of beads that stretch 200–400 meters from the sprayer's nozzle (Blasco et al., 2002). The inclusion and interaction with the insect or illness is more uniform since the beads are framed in a fog or haze. Because of this, even if the muskiness is modest, little beads are unlikely to reach their desired destination. This is a water-powered sprayer's component list: tank, syphon with initiator, weight measuring device, control valve, help valves and valves for managing the spray pattern and the source of power for driving the spray pattern.

This sprayer uses a gaseous energy source

The Gaseous Energy Sprayer's high-speed air stream is created by blowers. An air stream is guided down the pipe toward its conclusion by a diffuser plate, allowing spray liquid to flow. To get to where it needs to go, a liquid or residue must be carried through the air.

Sprayer with centrifugal energy

A fast-turning device in the Centrifugal Energy Sprayer can be a level, a concave or flat plate, a wire mesh cage or bucket, a piercing chamber, or a brush. Water from the atomizer exits the outer edges of the atomizer and is atomized by diffusive power as it passes through the focal point of this device's shower liquid. It is not necessary for a sprayer to have a fan in order to distribute droplets (Bond and Grundy, 2001).

Sprayer that uses kinetic energy as a propellant

Gravity directs the spray liquid to a vibrating or swaying spout, creating a fan-like spray pattern with the Kinetic Energy Sprayer. This equipment's main duty is to spray herbicides (Chang and Lin, 2018).

Impact of AI on agriculture in rural areas

The meaning of neediness as featured before is a diverse peculiarity at the end of the day neediness is complex. It shows itself in absence of pay, absence of schooling and now and again absence of social help and even food weakness. This for the most part influences rustic regions where the vast majority of the destitute individual's dwell. As indicated by the World Bank, farming is the wellspring of work in regions where destitution is more common. Computer based intelligence applications can address the different difficulties that are looked by individuals at the lower part of the pay conveyance particularly the base 40%. Despite the fact that a large portion of destitute individuals can't buy AI-empowered gear, it has been contended that these individuals can straightforwardly profit from AI through AI administration arrangements on their cell phones (Choudhary et al., 2019). Nuru, an artificial intelligence application that was used in Kenya, Mozambique, and Tanzania, is a good example of how this technology could be used in the developing world. Ranchers used this app to document leaf damage in images taken by specialists sent to assist in spotting one of East Africa's most elusive pests, which has been threatening homesteads' income and food security for years. As a result of artificial intelligence, cell phone data can be a powerful indicator of wealth, education, and even health status. Microloans, personalized mentoring, and seeking health and medication advice can all be delivered through mobile applications using this technology. As a primary use of AI applications, AI discourse acknowledgment and discourse to message features are used to help the most disadvantaged persons gain access to message-based apps. In most country regions that are a long way from the metropolitan regions, AI through picture acknowledgment can be utilized in the evaluation of microinsurance cases of ranchers.

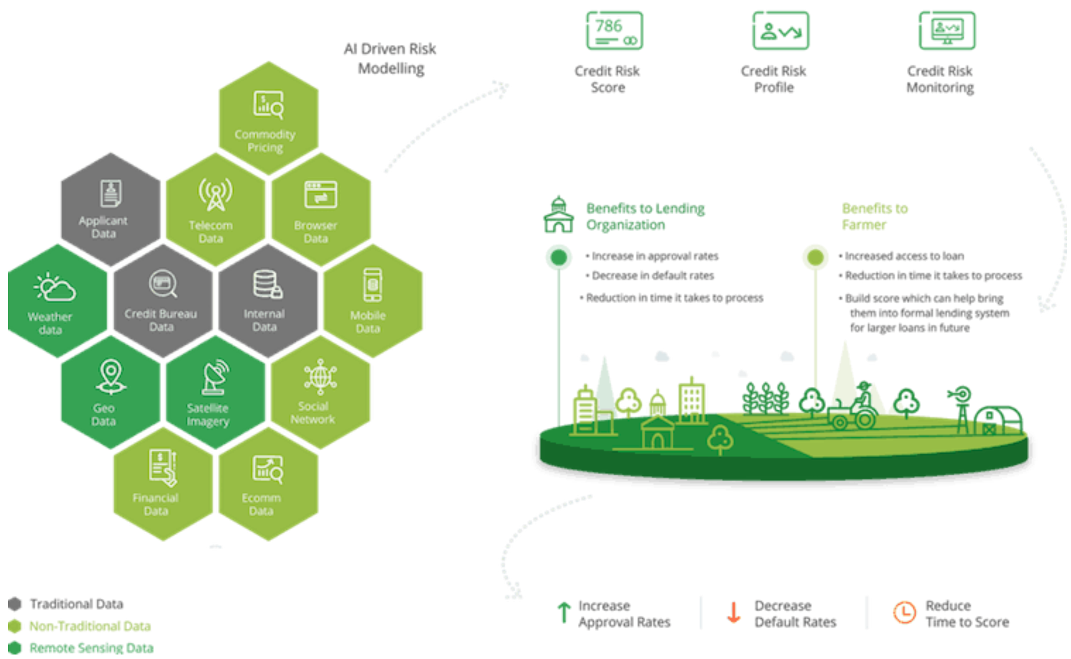

Figure 4: AI role in agriculture in rural areas. Source: Chung et al. (2016).

Furthermore, become self-sufficient in terms of nutrition. In 2020, the Decentralized AI Alliance declared that AI can alleviate poverty by improving soil development for growing crops and animal husbandry as a means of providing food and other essentials. Robots can now aid farmers in harvesting crops and predict the best methods for farmers to grow diverse harvests through the use of AI technologies. Utilizing mechanical technology, AI is turning into a significant variable in tackling widespread starvation Google and Stanford University's Sustainability what's more, Artificial Intelligence Lab are making progress in this area. These organizations are working with AI programs in agribusiness that are doing a lot of work on growing, helping to identify sicknesses, predicting harvest yields, and identifying locations at risk of food shortage (Cillis et al., 2018). One model where AI is being applied is through Farm View program made by specialists from Carnegie Mellon University (CMU) to assist ranchers with developing more food utilizing similar number of harvests. This work is being applied to concoct fast answers for the basic issue of paid ascent in populace. It is assessed that continuously 2050, roughly 9.8 billion individuals will live in the world, and this will increment food shortage making this point extremely basic. Be that as it may, the accessibility of AI will assist with further developing cultivating techniques detecting and advanced mechanics innovations to further develop plant reproducing and crop the executives. Specialists are caught up with gathering a great deal of data utilizing robots, robots, and fixed sensors to expand yields of dry spell and hotness safe harvests that can flourish in starvation-stricken countries. Through AI innovation analysts and AI advances information is dissected to figure out what variables yield more sorghum. One more illustration of where AI is helping a ton in agribusiness is through industry.

PlantMD. Shaza Mehdi and Nile Ravanell, two Georgia high school students, created PlantMD as a class project. A rancher can use this software to find out if his plants are sick thanks to the features it offers. Google's TensorFlow AI library was used to build this application. At Penn State, a group called Plant Village was working on an application named Nuru, which was affecting the PlantMD application that they were working on. To combat infection and irritating powerlessness in cassava, one of the yields that feed a major fraction of a billion Africans every day, the application (Nuru) was developed as before mentioned. Ranchers experienced issues in examining and dealing with each yield (Costa et al., 2012). Because of the accessibility of AI, AI is currently used to increment productivity during the time spent illness and vermin control. "An AI model was prepared utilizing large number of characterized cassava pictures and the model was transformed into an application where ranchers can send pictures of their yield and get data which empowers them to distinguish sicknesses with choices accessible to deal with the illnesses". Thusly, AI is helping African agribusiness to be reasonable which can assist farming with taking care of individuals. Additionally, Stanford University is using AI to comprehend and foresee crop yields in soybeans. Moreover, It is accepted that AI can likewise help with finding places in creating and immature countries with food instability issues through satellite innovation. The following area is framing the way that AI can help in the instruction area (De Oca et al., 2018).

This large number of advancements are upheld by different researchers who explored the significance of AI in the development and improvement of economies, for example, the total populace is supposed to increment to 2 billion of every 2050, while the arable region is supposed to develop by just 5%. Accordingly, shrewd and effective cultivating methods fuelled by AI and AI are important to further develop farming efficiency. The use of AI has been clear in the rural area. To address some of the issues affecting the horticultural sector and increase yields, AI plays an important role. When it comes to things like ensuring that the soil is properly treated, disease and irritant invasion control is in place, ensuring that large information needs are met, and reducing the information gap between ranchers and technology, there are a number of options (Dela Cruz et al., 2017).

AI impact on education

Man-made intelligence can help with raising the degrees of schooling for unfortunate youngsters the different strategies which incorporate adjusted learning procedures utilizing PC calculations to energize communication with the student as well as thinking of training that is tailor-made for the requirements of every student. Utilizing Computer based intelligence, it is exceptionally conceivable to find the particular advancing necessities of every student and have the option to fulfil these prerequisites utilizing different strategies for learning. In other exceptional conditions, insightful visit loads up are utilized as coaches breaking the cash hindrance to training to students who come from unfortunate regions which will assist with addressing access issues lastly have the option to address imbalance simultaneously (Dukes and Cardenas-Lailhacar, 2009).

During the COVID-19 social separating, the use of Industry 4.0 technology helped students have the opportunity to continue their education even during the lockdown. The concentrate too observed that innovation could build admittance to training particularly online instruction where space is anything but a restricting component. One of the training projects where Artificial Intelligence (AI) is helping to improve education in Kenya, Ghana, and Côte d'Ivoire through the Eneza Education social initiative. In this regard, AI is playing a significant role in the success of value education. This also gives teachers the ability to provide thorough and even-handed training, allowing them to unlock students' hitherto untapped capacity for learning. the importance of AI in education amid the COVID-19 pandemic lockdown. Despite the fact that they argued that it would be difficult for AI to take over school administration, AI will play a major role in instruction during the COVID-19 pandemic.

AI and Digital Financial consideration

Advanced monetary incorporation is seen as an approach to contacting the families who are not monetarily dynamic, that is the individuals who can't appreciate formal monetary administrations that are intended to address their issues. Women, young people, and the impoverished, particularly those still living in rural areas, are excluded from the formal financial system. Conventional ways of alleviating poverty and increasing social well-being are being disrupted as AI alters the cost of access to goods and services, how data is generated, and how products are created. The difficulties related with improvement are progressively becoming entwined with innovation where the objectives of finishing neediness and helping shared thriving are turning out to be fundamentally subject to outfitting the force of advancements like AI and simultaneously searching for ways of limiting the dangers related with these advances.

It has been laid out that in developing business sectors nations are starting to utilize essential AI to concoct answers for basic difficulties of improvement, particularly in the arrangement of monetary administrations to underserved and unserved populaces (Garre and Harish, 2018)The enormous advancement in fundamental AI calculations and the development in the quantity of innovation clients made it workable for developing business sectors to utilize AI arrangements like credit scoring and designated publicizing. A few early instances of AI being conveyed in monetary business sectors remember M-Kajy in Madagascar, M-Shwari in East

Africa, and Ant Financial in East Asia. By employing artificial intelligence (AI) techniques, M-Shwari has created an estimate of the likelihood of potential borrowers failing to repay their loans, which has made it possible for 21 million Kenyans to receive small loans before the year ends. AI is driving advances in monetary administrations by relying on modern information such as mobile phone call records, portable cash exchanges information, instant messaging, and address books, all of which are based on modern information.

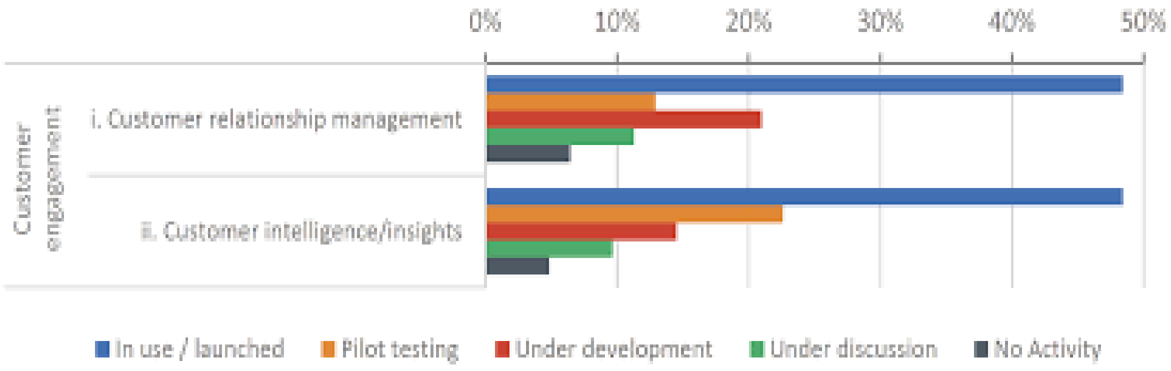

Figure 5: AI and financial sectors. Source: Pedersen and Blackmore (2008).

AI also contributes to lessening the data asymmetry in situations when borrowers, like first-time borrowers and those without a bank account, require a financial history. Furthermore, AI is improving monetary administrations by automating credit rating, a cycle previously assigned to human resources in more traditional monetary foundations. Artificial Intelligence (AI) can be used to analyses a lot of cell phone data in order to provide clients in emerging economies with fast financial analyses. Once the client has been offered an advance by consuming record information, the scoring calculation is further developed. Offering microloans to customers in countries like Kenya, Nigeria, India, and Mexico who do not have bank accounts is one way that Branch One of the fintech companies is using this method to microloans.

Challenges and scope for the future

More than a few major issues have been addressed by agriculture in recent years, including the lack of irrigation system, changes in temperature, and a greater density of groundwater. The reception of various cognitive solutions has a significant impact on the future of cultivating. An extensive amount of work remains, although a few products are already on the market. It's early days for farming when it comes to adopting autonomous decision-making and predictive solutions to deal with the real-world difficulties faced by farmers. For artificial intelligence (AI) to reach its full potential in agriculture, more robust applications are needed. It can make real-time decisions and use a suitable framework/platform efficiently if this is the case, and it will be able to react to rapidly changing environmental conditions. The high price of commercially available cognitive farming systems should also be taken into account. Solutions must become more affordable to make technology more accessible to a broader range of people. The solutions would be more accessible to farmers if they were built on open source platforms, which would lower their cost of entry (Pharne et al., 2018). Higher yields and more consistent crops can be achieved with the use of this technique. India is one country where farmers are totally dependent on the monsoon season to grow their crops. They rely heavily on weather forecasts, particularly for rain-fed agriculture. Predicting the weather and other agricultural conditions like land quality, groundwater, crop cycle and pest attack will benefit from AI technology. Farmers will be relieved of many of their anxieties thanks to AI technology's ability to accurately predict the future. When it comes to agriculture, the use of AI-powered sensors is extremely beneficial. The information will be helpful in increasing output. These sensors have a wide range of applications in agriculture. The harvesting robots can also be equipped with AI-powered sensors in order to collect data. AI-based advisories are thought to be useful in increasing production by 30%.

In farming, crop damage due to natural disasters, such as pest attacks, is the biggest obstacle to overcome. Farmers often lose their crops due to a lack of information. To safeguard their crops from cyber-attacks, farmers could benefit from this technology. This is where AI-enabled image recognition comes in. Many companies are using drones to keep an eye on production and identify any pests that might be lurking in the area. A system for monitoring and protecting crops is warranted because similar efforts have been successful in the past. Many hybrid cultivations have been developed to help farmers generate more money in a short amount of time, thanks to the advancements in technology. Use of artificial intelligence (AI) can help farmers cultivate their crops and provide a welcome environment for their customers. Using the right algorithms, it is possible to reduce food waste, which saves time and money while also promoting long-term well-being, according to data from reputable institutions. Using AI and other cutting-edge technologies, digital transformation in agriculture has a better chance of succeeding. However, all of this is contingent on the enormous amount of data that can only be gathered once or twice a year due to the production process. To keep up with the ever-changing world of agriculture, farmers have turned to artificial intelligence (AI) and the implementation of digital transformation technologies (Zimdahl, 2010).

Conclusion

Additionally, a lack of efficient irrigation systems as well as weeds and plant monitoring problems are among the issues that plague the agricultural industry. Technological advances, on the other hand, can enhance performance and so help to alleviate these problems. Artificial intelligence (AI)-driven techniques, such as remote sensors for sensing soil moisture content and GPS-assisted irrigation, can improve it. Precision weeding techniques have solved the problem of farmers losing a considerable proportion of crops during the weeding process. Pesticide and herbicide use are reduced by using autonomous robots, which are also more efficient than human labourers. Farmers may utilize drones to spray pesticides and herbicides more efficiently on their fields, and they can no longer be bothered with plant monitoring. First, a shortage of resources and jobs can be attributed to human brain power in agricultural concerns. It used to take a long time and a lot of effort to manually test agricultural attributes such as plant height, soil texture, and content. It is possible to do high-throughput phenotyping in a safe and efficient manner using a variety of different methods. This has the advantage of being flexible and advantageous, as well as providing on-demand access to data and spatial objectives.

References

ABDULLAHI, H. S., MAHIEDDINE, F. & SHERIFF, R. E. 2015, July. Technology impact on agricultural productivity: A review of precision agriculture using unmanned aerial vehicles. *In:* International conference on wireless and satellite systems (pp. 388-400), Springer, Cham.

AHIRWAR, S., SWARNKAR, R., BHUKYA, S. & NAMWADE, G. 2019. Application of drone in agriculture. *International Journal of Current Microbiology and Applied Sciences*, 8(01), 2500-2505.

AITKENHEAD, M. J., MCDONALD, A. J. S., DAWSON, J. J., COUPER, G., SMART, R. P., BILLET, M.... & PALMER, S. 2003. A novel method for training neural networks for time-series prediction in environmental systems. *Ecological Modelling*, 162(1-2), 87-95.

ALBAJI, M., SHAHNAZARI, A., BEHZAD, M., NASERI, A., BOROOMANDNASAB, S., & GOLABI, M. 2010. Comparison of different irrigation methods based on the parametric evaluation approach. *In: Dosalegh plain: Iran. Agricultural water management,* 97(7), 1093-1098.

ANAND, K., JAYAKUMAR, C., MUTHU, M. & AMIRNENI, S. 2015, July. Automatic drip irrigation system using fuzzy logic and mobile technology. *In:* 2015 IEEE Technological Innovation in ICT for Agriculture and Rural Development (TIAR) (pp. 54-58). IEEE.

ARVIND, G., ATHIRA, V. G., HARIPRYIA, H., RANI, R. A. & ARAVIND, S. 2017, April. Automated irrigation with advanced seed germination and pest control. *In:* 2017 IEEE Technological Innovations in ICT for Agriculture and Rural Development (TIAR) (pp. 64-67). IEEE.

BAK T. & Jakobsen, H. 2004. Agricultural robotic platform with four wheel steering for weed detection. *Biosystems Engineering*, 87(2), 125-136.

BAKKER, T., ASSELT, K. V., BONTSEMA, J., MÜLLER, J. & STRATEN, G. V. 2006. An autonomous weeding robot for organic farming. *In:* Field and Service Robotics (pp. 579-590). Springer, Berlin, Heidelberg.

BENDIG, J., BOLTEN, A. & BARETH, G. 2012. Introducing a low-cost mini-UAV for thermal-and multispectral-imaging. *Int. Arch. Photogramm. Remote Sens. Spat. Inf. Sci*, 39, 345-349.

BHASKARANAND, M. & GIBSON, J. D. 2011, November. Low-complexity video encoding for UAV reconnaissance and surveillance. *In:* 2011-MILCOM 2011 Military Communications Conference (pp. 1633-1638). IEEE.

BIRRELL, S. J., SUDDUTH, K. A. & BORGELT, S. C. 1996. Comparison of sensors and techniques for crop yield mapping. *Computers and Electronics in agriculture*, 14(2-3), 215-233.

BLASCO, J., ALEIXOS, N., ROGER, J. M., RABATEL, G. & MOLTÓ, E. 2002. AE—Automation and emerging technologies: Robotic weed control using machine vision. *Biosystems Engineering*, 83(2), 149-157.

BOND, W. & GRUNDY, A. C. 2001. Non-chemical weed management in organic farming systems. *Weed research*, 41(5), 383-405.

CHANG, C. L., & LIN, K. M. 2018. Smart agricultural machine with a computer vision-based weeding and variable-rate irrigation scheme. *Robotics*, 7(3), 38.

CHOUDHARY, S., GAURAV, V., SINGH, A. & AGARWAL, S. 2019. Autonomous crop irrigation system using artificial intelligence. *Int. J. Eng. Adv. Technol*, 8, 46-51.

CHUNG, S. O., CHOI, M. C., LEE, K. H., KIM, Y. J., HONG, S. J. & LI, M. 2016. Sensing technologies for grain crop yield monitoring systems: A review. *Journal of Biosystems Engineering,* 41(4), 408-417.

CILLIS, D., PEZZUOLO, A., MARINELLO, F. & SARTORI, L. 2018. Field-scale electrical resistivity profiling mapping for delineating soil condition in a nitrate vulnerable zone. *Applied Soil Ecology*, 123, 780-786.

COSTA, F. G., UEYAMA, J., BRAUN, T., PESSIN, G., OSÓRIO, F. S. & VARGAS, P. A. 2012, July. The use of unmanned aerial vehicles and wireless sensor network in agricultural applications. *In:* 2012 IEEE International Geoscience and Remote Sensing Symposium (pp. 5045-5048). IEEE.

DE OCA, A. M., ARREOLA, L., FLORES, A., SANCHEZ, J. & FLORES, G. 2018, June. Low-cost multispectral imaging system for crop monitoring. *In:* 2018 International Conference on Unmanned Aircraft Systems (ICUAS) (pp. 443-451). IEEE.

DELA CRUZ, J. R., BALDOVINO, R. G., BANDALA, A. A. & DADIOS, E. P. 2017, May. Water usage optimization of Smart Farm Automated Irrigation System using artificial neural network. *In:* 2017 5th International Conference on Information and Communication Technology (ICoIC7) (pp. 1-5). IEEE.

DUKES, M. D., SHEDD, M. & CARDENAS-LAILHACAR, B. 2009. Smart Irrigation Controllers: How Do Soil Moisture Sensor (SMS) Irrigation Controllers Work?. EDIS, 2009(2).

GARRE, P. & Harish, A. 2018, December. Autonomous agricultural pesticide spraying uav. *In:* IOP Conference Series: Materials Science and Engineering (Vol. 455, No. 1, p. 012030). IOP Publishing.

PEDERSEN, S. M., FOUNTAS, S. & BLACKMORE, S. 2008. Agricultural robots—Applications and economic perspectives, IntechOpen.

PHARNE, I. D., KANASE, S., PATWEGAR, S., PATIL, P., PORE, A. & KADAM, Y. 2018. Agriculture drone sprayer. *International Journal of Recent Trends in Engineering & Research* (IJRTER), 4(3).

TALAVIYA, T., SHAH, D., PATEL, N., YAGNIK, H. & SHAH, M. (2020). Implementation of artificial intelligence in agriculture for optimisation of irrigation and application of pesticides and herbicides. *Artificial Intelligence in Agriculture*, 4, 58-73.

ZIMDAHL, R. L. 2010. Ethics for weed science. *Pakistan Journal of Weed Science Research*, 16(2).