ISSN 1533-9211
DOI: 10.5281/zenodo.10071174

USING AI FOR DISEASE PREVENTION IN PRECISION FARMING AND PREDICTIVE ANALYSIS: A COMPREHENSIVE REVIEW

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Abstract

Artificial intelligence (AI) is currently the most common and effective technology for satellite industries. In all areas of the industry, AI is having a significant impact on efforts to automate certain tasks using intelligent machinery. One of the oldest and most significant vocations in the world is agriculture and farming. Applications and tools for AI in agriculture have been created to assist farmers in precise and regulated farming by giving them the right instructions on water management, crop rotation, timely harvesting, and the type of crop to be cultivated, optimal planting, and pest control. Climate change, population growth, and concerns about food security have compelled the sector to look for more creative ways to safeguard and boost agricultural productivity. With the aid of a Cloud computing, machine learning algorithms are used to evaluate farms for the detection of diseases and pests, analyze crop sustainability, and anticipate weather using satellite data. The most recent developments in precision farming and a global predictive analysis of agriculture from an Indian perspective are discussed in this study. AI, IoT, and cloud computing are crucial for crop protection and timely cropping growth given the climate in India. These methods are tested and produce results that are in line with expectations.

Index Terms: AI, Life Cycle of Agriculture, Machine Learning, Predictive Analytics, Precision and Traditional Farming.

I. INTRODUCTION

Agriculture and farming contribute significantly to the GDP (Gross Domestic Product) of both emerging and many developed countries. As a result, it is urgent that existing farming methods be improved upon. It will assist in addressing the world issue such as climate change and diseases such as draught as well as the flourishing sustainable development of humans. Better technology will increase yield, hence reducing the likelihood of famine and malnutrition. In order for the technology to have a global influence on billions of people, it must be reasonably priced.

II. TRADITIONAL FARMING AND PREDICTIVE ANALYTICS

With the sole purpose of providing effective irrigation via rain guns, the Agriculture Department has largely utilized predictive analytics based on satellite data to forecast crops for farms that are water-stressed. A different technological program that focused mostly on providing assistance to farmers who depend on rain fell at the same time and was started past year, through the use of a smartphone and m-trading, small and marginal farmers are now able to ensure that their fresh products are sold directly to various enterprises around the country.

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A. Conceptual Framework

The terms "precision farming" and "predictive analytics" are used in relation to the use of agricultural sustainability satellites, machine learning algorithms, and weather prediction, respectively. The aspect of artificial intelligence that is used to carry out learning, reasoning, and perception is in the context and is founded on the premise of replicating humanArtificial intelligence has three main objectives: learning, reasoning, and perception.Ar tificial intelligence is founded on the idea that a machinecan effortlessly mimic human intelli gence and carry out tasks at all levels, from the most basic to the most sophisticated.The econ omic sector is very crucial to agriculture & farmingGlobally, it is a $5 trillion industry.By 20 50, the world's population is projected to exceed nine billion, necessitating a 70% increase in agricultural output to meet the need.Water and resource shortages due to the growing global p opulation make it difficult to meet the demandsupply cycle.Therefore, a clear strategy is need ed to make farming the most fruitful business.We are at the start of a golden age of AI, accor ding to JEFF BEZOS, CEO of Amazon.

"We're at beginning of a golden age of AI. Recent advancements have already led to invention that previously lived in the realm of science fiction – and we have only scratched the surface of what's possible"

B. Life Challenges of Traditional farming

Inclimate variables including rainfall, temperature, and humidity are crucial to the life cycle o f agriculture.As a result of ongoing deforestation and pollution, the climate has changed, mak ing it more challenging for farmers to make judgements about how to prepare the soil, plant s eeds, and harvest.

Figure 1: Life Cycle of Traditional Farming

ISSN 1533-9211
DOI: 10.5281/zenodo.10071174

Every crop needs a particular type of soil nutrition.A lack of the three essential nutrients nitrogen (N), phosphorous (P) and potassium (K)—can result in crops of low quality. If the agricultural life cycle is not safeguarded from weeds, the cost output may rise. This is true because weeds draw nutrients from the soil, leaving the soil undernourished.

To accomplish crucial agricultural activities, such as harvesting crops at a bigger volume and faster rate than human laborers, agricultural robots are built and programmed independently. To track and forecast diverse environmental effects on agricultural productivity, such as weather variations, predictive analytics of machine learning models are being created. Concerns about food security population expansion, and climate change have prompted the sector to look for more creative ways to safeguard & boost agricultural productivity. This sparked the technological development of the sector.

C. Life Challenges of Precision Forming

AI technologies are being used by the agriculture sector to increase crop yield, control pests, monitor soil conditions and growing conditions, organize data for farmers, lighten their work load, and improve a variety of agriculture-related tasks throughout the entire food supply chain.

Use of Weather Forecasting: Farmers can use weather fore casting to plan the sort of crop to be cultivated, including the seed-sowing time, with the aid of AI. Because of the climatic changes brought on by rising pollution, farmers find it challenging to choose the ideal time for seeding.

Figure 2: Weather Forecasting of Farming

Drones and Computer Vision for Crop Analysis: Aerial technology and AI are being used by businesses today to check crop health. One business bringing drone technology to vineyards is

ISSN 1533-9211
DOI: 10.5281/zenodo.10071174

Sky Squirrel Technologies Inc. Users can connect a USB drive from the drone to a computer and upload the recorded data to a cloud disc once the drone has completed its path. Sky Squirrel integrates and analyses the data and photographs it has collected using algorithms to produce a comprehensive report on the health of the vineyard, particularly the state of the grapevine leaves. Reading the "health" of the leaves is frequently an excellent proxy for knowing the health of the plants and their fruit as a whole because grapevine leaves are frequently telltales for grapevine illnesses like moulds and bacteria.

Soil and Crop Health Monitoring System: The type of crop to be cultivated and the quality of the crop are both influenced by the soil's nutrition and type. It is challenging to assess the quality of the soil because of the worsening deforestation; an IT Startup established in Germany PEAT has created an AI-based tool called Plantix that can detect nutrient deficits in soil as well as plant pests and illnesses, giving farmers insight on how much fertilizer to use to boost the quality of their yield. Utilizing the app's image recognition-based technology, farmers may use cell-phones to take pictures of their plants

III. PRECISION FARMING AND PREDICTIVE ANALYTICS

A. Satellites for Weather Prediction & Crop Sustainability

Artificial Intelligence-powered tools forecast weather conditions, analyze crop sustainability, and evaluate farms for the presence of diseases or pests and poor plant nutrition on farms using data like temperature, precipitation, wind speed, and solar radiation in conjunction with images captured by satellites and drones. Where a Colorado-based corporation utilises satellites and machine learning algorithms to forecast the weather, assess the sustainability of crops, and assess farms for the presence of diseases and pests. For instance, daily weather forecasts can range from quite local to extremely global and are tailored based on the demands of each client. The website of the business lists farmers, agricultural experts, and researchers as examples of its clients. Although we've already covered prediction this year, the video below provides an excellent overview of some of the key technologies at work.

Additionally, the company asserts that it gives consumers daily access to more than a billion points of agronomic data. Temperature, precipitation, wind speed, and solar radiation are all included in the data sources, "along with comparisons to historic values for anywhere on the agricultural Earth." Farm Shots, a Raleigh, North Carolina-based firm, also specializes in the analysis of agricultural data generated from satellite and drone imagery. The company's specific goal is to "detect diseases, pests, and poor plant nutrition on farms." For instance, the business asserts that its software can tell users of the precise locations where fertilizer is required. It is anticipated that it will reduce fertilizer usage by over 40%. Using mobile devices is promoted for the software.

With current technology as basic as an SMS-enabled phone and the Sowing App, farmers without connectivity can profit from AI. Farmers with Wi-Fi connectivity can utilise AI apps to get a constantly AI-tailored plan for their farms, in the meantime. Farmers can meet the increased demand for food while growing output and revenues responsibly and without

ISSN 1533-9211
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diminishing priceless natural resources with the help of IoT and AI-driven technologies. AI will eventually assist farmers in becoming agricultural scientists who can use data to maximize yields right down to individual plant rows.

B. Application of AI for Farming Challenges

Real game changers can be found in predictive analytic. With AI, farmers can process and gather a vastly increased amount of data than they could without it, farmer may use AI to address several major issues, including market demand analysis, pricing predictions, and choosing the best window for planting and harvesting. Additionally, artificial intelligence can track the readiness of food, forecast weather, make fertilizer suggestion, and check soil health. At every stage of the crop cultivation process, farmers can improve to all these factors.

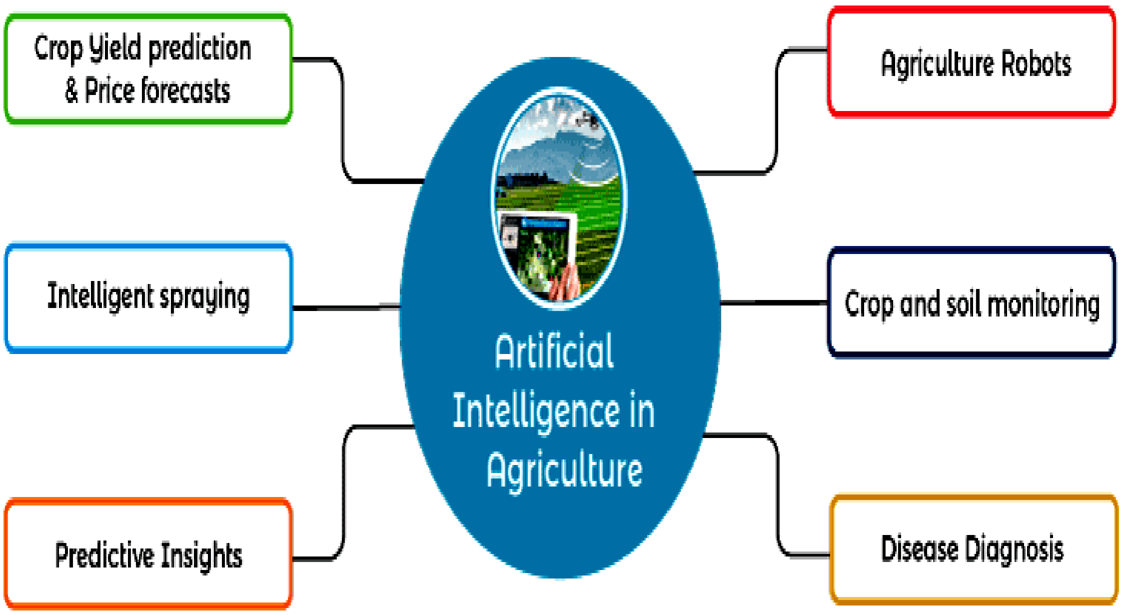

Figure 3: Applications of AI

C. AI and Cost Saving

Precision agriculture is one type of farm management strategy that can assist farmers in producing more crops with fewer resources. This artificial intelligence-powered method may be the future of farming. With this strategy, farmers are able to maximize production and cut costs by combining the best oil management practices, variable rate technologies, and most effective data management practices. Farmers can identify fields that require irrigation, fertilization, or pesticide application by using real-time information from AI. Additionally, cutting-edge farming techniques like agriculture may assist boost food output while using fewer resources. Herbicide use is reduced, harvest quality is improved, earnings are increased, and there are significant cost savings as a result.

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D. Lengthy Technology Adoption Process

It is crucial to convey to the farmer that AI is really a more sophisticated form of earlier, less complex technology for collecting, analyzing, and monitoring field data. For it to function, a suitable technological infrastructure is needed. Even farms with some technology installed are having trouble advancing. Software firms are also faced with difficulties. They could start by introducing them to simpler technology, like a trading platform for agricultural commodities. After farmers become accustomed to a simpler solution, it will be appropriate to advance and provide something else, such as AI functions.

E. Lake of Experience with Emerging Technologies

The agricultural industries in developing nations are distinct from those in Western Europe and the US. While AI in agriculture may be advantageous in some areas, it is not widely used in others. Farmers in these areas need assistance implementing it. Therefore, IT companies may need to adopt a proactive strategy if they want to conduct business in areas with developing agricultural economies. They will need to impart training and continuing support for farmers and agribusiness owners willing to adopt innovative solutions in additions to supplying their products.

IV. PRIVACY AND SECURITY ISSUES IN INDIA

The use of AI in general is not subject to defined norms or policies, therefore smart farming and precision agriculture create a number of legal questions. Additionally, farmers may have major issues as a result of privacy and security risks like cyber-attacks and data leaks, rendering them vulnerable to these dangers. Agriculture was revolutionized by AI, which made agricultural automation a global hot topic and allowed farmers to boost production with high-quality and efficient marketing. The development and use of remote sensing technologies is made feasible by advancements in computer vision, mechatronics, AI, and ML, this allows for the identification and management of plants, weeds pests and diseases.

The most revolutionary technology in agricultural service is cognitive computing, which makes it easier to learn about, comprehend, and interact with many settings for maximum production. Microsoft offers advice on farming, land use, and fertilizer in India. The outcomes of this initiative greater average yield by 30%. For intelligent data integration relating to historical meteorology, soil reports, current research, rainfall, insect infections, along with drone imagery for in-depth field analysis, crop monitoring, and field surveys, proximity sensing, remote sensing, the IoT and Image-based precision farming are being used.

V. AI DECISION ON CROP INPUTS-MARKET AND PRICE

As you know in AI summit (RAISE 2020) Indian Prime Minister addresses *"I SEE A BIG ROLE FOR AI IN EMPOWERING AGRICULTURE, HEALTHCARE, EDUCATION, CREATING NEXT-GENERATION URBAN INFRASTRUCTURE AND ADRESSING URBAN ISSUES"* during AI for Social Empowerment Summit.

ISSN 1533-9211
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Particularly in the aftermath of recent agricultural reforms that have opened floodgates to private sector investments in agriculture, artificial intelligence-based agritech applications are poised to unlock value in agriculture. Through 133 deals, the financial year 2019-2020 saw the growth of Indian agri-food tech start-ups to the half over $1 billion. Indian's agricultural exports increased to $37.4 billion in 2019 and are expected to rise much more thanks to investments in the supply chain, better storage, and pack again.

All of these actions will significantly lessen agrarian stress and ensure farmers receive fair prices. Investments in technology are boosting this increase in agricultural output and productivity. AI and other disruptive technologies are having a significant beneficial impact on Indian agriculture, and the nation's agri-tech firms are working harder than ever to create and implement AI-based solutions. Globally, the value of AI applications in agriculture increased to $852.2 million in 2019 and it is predicted that this figure would nearly double to $8.38 billion by 2030 or a roughly 25% increase. Only 1% of the estimated $24 billion potential exists in the $204 million Indian agri-tech market today.

Farmers' access to markets, inputs, data, advice, loans, and insurance will be improved through the use of technology in agriculture. An effective supply chain that is demand-driven and efficient may be built with the use of timely, reliable data and analytics. In order to build predictive models that can significantly improve decisions about seeds, fertilisers, and pesticides that are crucial in both the pre-harvest and post-harvest stages, agricultural data can be collected and matched with weather data, soil healthcare data, mandi prices, and photographs taken using sensors, IoT devices, drones, and satellite images. The majority of these AI models are low-cost and cheap, and they can significantly improve the ecosystem surrounding agriculture.

India has achieved remarkable progress in the services sector, but the industry still accounts for 16% of the country's GDP and continues to employ 49% of the workforce. Therefore, in addition to ensuring food security for the nation, improvements in agriculture would have a significant impact on the wellbeing of a sizable portion of the Indian population. It is a significant problem to feed over a billion people in India with the available land resources, and to do this, significant technological advancement is needed to enable a significant increase in agricultural production. The issues facing Indian agriculture are numerous and include a strong reliance on the monsoon, resource depletion and heavy use of resources (water, artificial fertilizers, and pesticides), degradation of the land and loss of soil fertility, poor yields per hectare, etc. By reducing supply chain restrictions and expanding market access, AI can play a catalytic role in boosting farm productivity. It could have a favorable effect on the entire agrarian value chain. By 2026, it is predicted that AI in global agriculture would present a $4 billion potential.

Increased AI use will result in more mechanisation of Indian agriculture, which would boost production through precision farming. Agriculture startups are attempting to incorporate AI-based technical solutions across a number of use cases, including assuring supply chain efficiencies, monitoring crop yield and soil fertility, and predicting agriculture analytics. Various AI and machine learning methods are employed in predictive agriculture analytics to

ISSN 1533-9211
DOI: 10.5281/zenodo.10071174

forecast the ideal time to plant seeds, receive notifications about upcoming pest assaults, etc. AI in agriculture enables the best possible use of farming data, enabling equipment like smart drones, self-driving tractors, soil sensors, and Agri-bots to operate and provide exceptional farming efficiency.

Industry collaboration with the government to develop a crop yield prediction model powered by AI in order to offer farmers real-time advising services is another example of AI innovation. The system's AI-based predictive technologies aid in boosting soil productivity, enhancing crop output, reducing input waste, and forewarning of pest or disease outbreaks.

To offer farmers with reliable information, this system makes use of remote sensing data from the Indian Space Research Organization (ISRO), information from soil health cards, weather forecasts from the India Meteorological Department (IMD), analyses of soil moisture and temperature, etc. Ten states across the nation, including Assam, Bihar, Jharkhand, Madhya Pradesh, Maharashtra, Rajasthan, and Uttar Pradesh, are participating in this programme. Similar to this, an increasing number of firms in India are already working to develop AI-based solutions in the agricultural sector. A startup has assessed agricultural damage and the amount of compensation due based on the cost of the damage done by using data science, artificial intelligence, and machine learning algorithms, as well as data sets from ISRO. Answers to questions about what is cultivated, what damage has occurred, and how much the damaged crops are worth are generally accurate.

Another AI business in India maps farmers' zones in remote locations, providing highly accurate answers to questions like who has been farming particular land, what is being grown, and what the soil quality is like there. All of these parties—crop insurers, seed suppliers, and state governments—want this information, so it is easy to create a business model around it. Additionally, farmers have access to all of this insightful information that enables them to make better decisions about their agricultural practices and add value. Predictive analytics and machine learning are being used by other agri-tech businesses to address the issue of input price volatility and insufficient input utilization. For large-scale quality testing, post-harvest food handling, and monitoring, imaging and AI traceability solutions are being developed. Data is assisting in the development of price transparency tools to detect supply chain fraud. In a similar vein, drones and agricultural robots (agri-bots) are being developed to guarantee efficient cultivation and harvesting.

Increased public and private funding is required to help these AI technologies scale, particularly from venture capitalists. With the recent reforms in the agricultural sector, there is a chance that contract farming investments will expand and technology will be introduced for higher yields and productivity. This will encourage the use of AI in agriculture even more. Global stakeholders have been given a venue to come together to finalise the roadmap for deploying AI for the common good thanks to the recently ended Responsible AI for Social Empowerment Summit - RAISE - 2020 Summit. Up to 321 international AI specialists from 21 different countries, as well as representatives from the agricultural sector, gathered on the RAISE 2020 platform to finalize strategies for creating ground-breaking AI-based products and accelerating the use of AI across industries.

The Seybold REPORT

ISSN 1533-9211

DOI: 10.5281/zenodo.10071174

India offers a fantastic potential for data scientists and AI professionals to create cutting-edge AI tools and solutions for agriculture because of the variety of its soil types, climate, and topography. Large and detailed data from Indian farms and farmers are used to assist develop AI solutions for the entire world, not just the nation. The opportunity for AI in Indian agriculture is unprecedented because to this one factor.

VI. AI-TECHNIQUES USED WORLDWIDE

Three stages are involved in acquiring engineering information for building the Soil Risk Characterization Decision Support System (SRC-DSS): knowledge acquisition, conceptual design, and system implementation.

Table I: AI-Techniques in SOIL Management

Applications	Technique	Strength	Limitation
1	MOM	Minimizes nitrate Leaching, maximizes production	Takes time. Limited only to nitrogen.
2	FuzzyLogic: SRC-DSS	Can classify soil based on possible risks.	Requires massive data. There weren't many cases examined.
3	DSS	Reduces erosion and sedimentary yield	Requires big data for training.
4	ANN	Predicts the activity of soil enzymes. Identifies and classifies soil structure accurately.	Measures a small number of soil enzymes. More classification is taken into account than soil performance enhancement.
5	ANN	Predict monthly mean soil temperature	Focuses mainly on temperature when determining how well soil will function.
6	ANN	Predicts Soil texture	Large data is necessary for training. Has limitations on where it can be used.
7	ANN	Predicts soil moisture	Weather conditions are hardly ever predictable, thus the prediction will eventually be wrong.
8	ANN	92% Accuracy	Need big data
9	ANN	Soil texture reports good	Not improve soil texture
10	ANN	Can estimate soil nutrients after erosion.	Restricted only NH4

The aforementioned table demonstrates that Management-oriented modeling (MOM) is composed of a simulator that rates each option created by plausible management alternatives and an evaluator that chooses which alternative satisfies the user-weighted multiple criteria to reduce nitrate leaching. In order to determine the shortest path between start nodes and goals, MOM employs "hill-climbing" as a tactical search strategy and "best-first" as a strategic search strategy. A digital elevation model (DEM) and hydrographic characteristics acquired from current coarse resolution soil maps are integrated to create an artificial neural network (ANN) model that predicts soil texture (sand, clay, and silt concentrations).

ISSN 1533-9211
DOI: 10.5281/zenodo.10071174

Table II: AI-Techniques in CROP Management

Applications	Technique	Strength	Limitation
1	CALEX	Can create guidelines for crop management activity scheduling.	Takes time. Limited only to nitrogen.
2	PROLOG	Avoid less used farm tools from the farm	Specified location
3	ANN	Predicts crop yield	Captures weather factors only in crop yield
4	ROBOTICS - Demeter	Up to 40 hectares of crop can harvest	Consumes lot of fuel its expansive
5	ROBOTICS	Almost 80% success rate in harvesting crop	Picking speed & Accuracy is slow
6	ANN	More than 90% success rate in detecting crop nutrition disorder	Little symptoms were consider
7	Fuzzy Cognitive Map	Predict and improve crop yield	Relatively slow
8	ANN	Predict crops to soil moisture and salinity	Only soil temperature and texture factors are consider
9	ANN and Fuzzy Logic	Minimize insects that attack crop	Inability between crop and weed
10	ANN	Predict Rice yield	Time consuming to particular climate.

The crop management techniques are summarized in Table II.

Table III: AI-Techniques in DISEASE Management

Applications	Technique	Strength	Limitation
1	ANN, GA, CVS	High speed with Multi-task	Dimension-based to effect good species
2	Rule-based expert, Data Base (DB)	Accurate results in the tested environment	Inefficiency of DB when implementing in large scale
3	Fuzzy logic, Web GIS	Cost effective, Eco-friendly	Inefficiency scatters distribution. Location determined by a mobile browser
4	FLWeb based Intelligent Disease Diagnosis System (WIDDS)	Respond promptly with nature of crop diseases	Limited usage of internet service. Only for seed crops were considered
5	FL &TTS Converter	Resolves plant pathological problems	Need high speed internet and a voice service its multimedia interface
6	Expert system using rule-base in disease detection	Faster treatment of diseases diagnosed and expansive.	Need more time to monitoring and built immunity to the preventive measure.
7	ANN, GIS	Accuracy is more than 95%	Internet needed some rural is not access

ISSN 1533-9211
DOI: 10.5281/zenodo.10071174

8	FuzzyXpest provides pest information supported internet services	High Precision in fore cast	Internet dependent
9	Web-Based Expert system	High Performance	Internet and web based
10	ANN	More than 90% prediction rate	Ann does not kill infections or reduces it effect

Table IV: AI-Techniques in WEED Management

Applications	Technique	Strength	Limitation
1	ANN, GA	High performance reduce trail & error	Need Big data
2	Optimizations of WEED, (IVO), ANN	Cost effective, Enhanced performance	Adapted with challenges of new data
3	Mechanical control of WEEDS, Robotics, Sensor machine learning	It saves time and removes resistant Weeds	Expensive of constant usage machines will reduce soil productivity
4	UAV, GA	Monitoring is quick and efficient of Weeds	Expensive, no control on Weeds
5	Prediction & Weed Management	Rate of High adaption and prediction level	Need Big data and usage expertise
6	ANN, Support vector machine	Quick detection stress in Crop with timely specific remedies	Detects only low level Nitrogen
7	Digital Image Analysis, GPS	Accuracy is more than 60% in success rate	More time consuming, nearly 4 years
8	UAV	Within short period of time to detect of high rate of Weed	Expensive and need human expertise
9	Learning Vector Quantization (LVQ), ANN	High Weed recognition rate with short processing time.	With help of method of data input to affected the AI's performance

In order to describe and estimate the dynamics of soil moisture, a remote sensing device that is integrated into a higher-order neural network (HONN) is used. Sowing is the first step in crop management, which also includes crop harvesting, crop storage, and crop distribution. It can be summed up as actions that increase the yield and growth of agricultural products. An agricultural management technique called PCM (Precision Crop Management) targets crop and soil inputs in accordance with field needs to maximize profitability and save the environment. Lack of timely, widely disseminated information on crop and soil conditions is the primary cause of PCM's shortcomings. To deal with a water shortage brought on by weather, oil, or insufficient irrigation, farmers must combine a variety of crop management techniques. It is preferable to use flexible decision-based crop management systems. Among the cropping options, a set of drought features and drought mitigation plans are crucial. Understanding weather patterns will undoubtedly aid farmers in making decisions that will provide a high and quality crop production.

ISSN 1533-9211

DOI: 10.5281/zenodo.10071174

PROLOGUE makes use of meteorological data, equipment capacity, labour availability, and details on authorized and prioritized operators, tractors, and tools to assess the operational behavior of a farm system. Additionally, it makes projections for the entire farm as well as for specific fields' gross income, net income, and crop production. By detecting numerous soil factors and parameters connected to the atmosphere, crop prediction methodology is utilized to anticipate the appropriate crop. Robotics suggests soil type, PH, nitrogen, phosphate, potassium, organic carbon, calcium, magnesium, sulphure, manganese, copper, iron, depth, temperature, rainfall, and humidity are among the factors that should be considered. Demeter is a computer-controlled speed-rowing machine that can arrange harvesting operations for an entire field and is outfitted with two video cameras and a global positioning system for navigation.

In order to effectively control illnesses and reduce losses, farmers should design a system based on an integrated disease control and management model, incorporating physical, chemical, and biological techniques [30]. AI approaches for disease control and management are required to decrease the time and financial viability [23]. Explanation Block (EB) is employed in order to provide a clear understanding of the logic used by the expert system's kernel [21]. The method for making intelligent inferences for agricultural disease management uses fuzzy logic-based rule promotion. A text-to-speech (TTS) converter was produced to enable text-to-talking user interfaces. TTS offers an interactive user experience with live web chat that is quite effective [25]. A rule-based and forward chaining inference engine was utilized to construct the system that aids in diagnosing illnesses and offers treatment recommendations in [26]. Even with comprehensive weed control techniques, as indicated in Table IV, crop losses caused by weeds in western Canada field crops are anticipated to surpass $500 million yearly [29]. As a result, a more skilled weed management technique was required to make up for this loss [30].

To separate the collected image from imagery, compute and convert the vegetation indexes to binary, detect crop rows, optimize parameters, and create a classification model, UAVs (unmanned aerial vehicles) [38] can be used. Since crops are typically arranged in rows, using a crop row identification method aids in effectively separating weed and crop pixels. Online weed detection was implemented using computer-based decision-making, global positioning system (GPS)-controlled patch spraying, and digital picture analysis from a UAV (drone) [36]. It is possible to control weeds in winter wheat, winter barley, maize and sugar beetroot. The drone [37] proceeded at a speed of 1.2 km/h and took 58.10 ms and 37.44 ms, respectively, to determine the locations of the tomato and weed for the spray controller.

VII. CONCLUSION

AI tools will be integrated into farmers' daily lives for precise farming that increases crop output and quality while using less resource. Businesses engaged in machine learning-based artificial intelligence Products and services like training data for agriculture, drones, and automated machine manufacturing will benefit more from technology improvement in the future, which will assist the globe address challenges with food supply for the expanding population.

AI-driven technologies are emerging to address issues affecting the sector, such as agricultural productivity, soil health, and herbicide resistance. Agricultural robots are a highly regarded application of AI in this industry. In the next three to five years, they will be utilized to carry out an expanding variety of activities. According to one research report, between 1980 and 2008, there was a 5.5 percent decrease in wheat production and a 3.8 percent decrease in maize production worldwide. Daily data that can be collected by drones and satellites is needed in the agricultural business to forecast changes and spot opportunities. In the upcoming decade, it is anticipated that machine vision applications and remote sensing using satellite data would become increasingly beneficial for large industrial farms. Farmers must have access to the most recent training to ensure the application of technologies for ongoing improvement. This will support the argument that these tools are valuable in the long run.

The effectiveness of AI technology often increases with the amount of high-quality data available, allowing the system to overcome a number of imaging challenges such bad illumination, poor alignment, and incorrect object cropping. These AI technologies and algorithms can be combined with mobile hardware to create a platform with the capacity to detect and find pests and diseases at a low cost, as well as to provide a prescription map (compatible with precision equipment) for the variable rate application of agrochemicals. These technologies will enable pesticide applicators to use less pesticide, pay less for it, and potentially have less of an impact on the environment by applying the right amount of pesticides just where they are required. Since agriculture is impacted by environmental elements that cannot be controlled, unlike other industries where risk is easier to predict and model, the acceptability of AI usage in the agriculture sector depends on thorough testing and validation of developing AI applications. AI will continue to be steadily adopted in the agricultural sector to improve farming productivity and farmers' overall financial and marketing skills!

Acknowledgements

The authors gratefully acknowledge the following scholars and experts for graciously permitting them to utilize their data and findings for the purposes of the present paper: Daniel Fagella, 2020; Naman Agarwal and Himanshu Agarwal, both of NITI Aayog, 2020; Pravar Jain, 2020; Abhishek singh, 2020; and Engineering Technology and Applied Science Research, Federal University Ndufu Alike Ikwo, 2019, Vol 9, No 4: 4377-4383

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