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INVESTIGATING STUDY ON THE USE OF AI AND ML TECHNOLOGY IN THE AGRICULTURE SECTOR

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ABSTRACT:
The integration of machine learning (ML) and artificial intelligence (AI) in agriculture is the subject of this study. Prior to delving into the difficulties encountered and solutions employed, it examines the farming techniques. Later on, it discusses the software that various companies have created to address the difficulties encountered in farming. It also discusses the AI start-ups that are now working to incorporate AI into agriculture. By providing a thorough review of the current state of AI and ML in agriculture as well as future prospects, the findings add knowledge to both academics and the agricultural industry. The study's exploration of agricultural research and artificial intelligence's application to it comes to a close.

KEYWORDS: Artificial Intelligence, Machine Learning, Precision Farming, Sensor Technologies, Smart Farming Systems, Data Privacy, Sustainable Agriculture

INTRODUCTION

The foundation of artificial intelligence (AI) is the idea that human intelligence may be characterized in a way that makes it easy for computers to mimic and carry out both simple and complicated activities. Learning, recognition, logical reasoning, and reasoning are among the objectives of artificial intelligence. Speech recognition, computer vision, expert systems, and natural language processing are a few specific uses of artificial intelligence. Self-driving car visual recognition systems, recommendation systems that make product recommendations based on past purchases, and Siri, Apple's virtual assistant, which recognizes voice and language, are a few examples.

Machine learning (ML) is the study of different computer algorithms that automatically get better with time by utilizing data and experience. It is a branch of artificial intelligence that enables more accurate outcome prediction in software applications without the need for explicit preparation. To forecast the output, machine learning algorithms employ historical data as input values. When a computer program becomes more proficient at a task with increased experience (E), it is said to be learning. T, for instance, is teaching a child the letters. After displaying the child numerous pictures of various alphabets, say the respective letters aloud. A child's experience serves as their training (E). The primary data (alphabet pictures) and supervisory data (alphabet speech) make up the training set. The child eventually accumulates experience, and after n training sessions, an evaluation is completed for the child. Simply show the child the alphabet picture during the evaluation, then ask them

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to pronounce it. Compare the two while the child is speaking, then determine the performance (P).

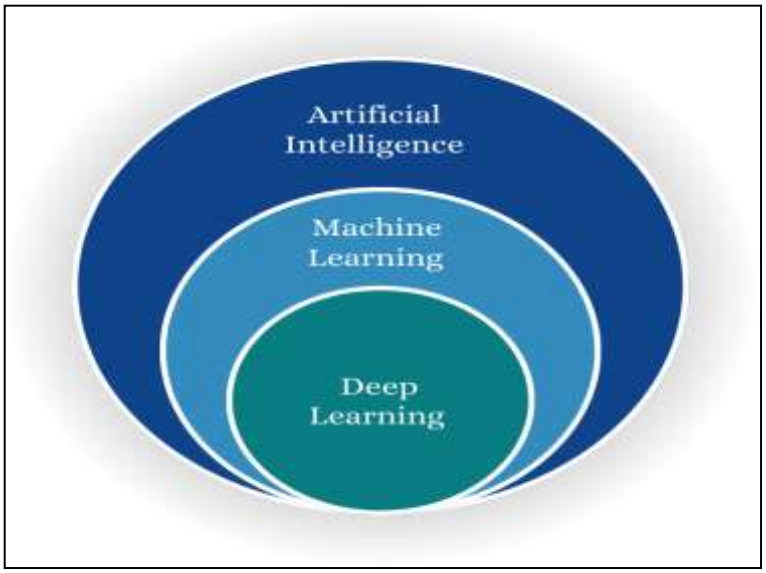

Figure 1. Artificial Intelligence subsets

Agriculture and farming are among the most significant and ancient professions worldwide. It has a significant impact on growing the economy. Globally, agriculture is a $5 trillion sector. By 2050, it is expected that there will be more than 9 billion people on the planet, meaning that 70% more agricultural output will be needed to feed everyone. Land, water, and other resources won't be enough to support the global supply and demand chain as the population expands. Thus, increasing productivity necessitates more astute strategies and productive farming. Therefore, several new automated procedures are being created and launched in order to meet these needs and generate fantastic work chances for many people in this area.

One of the most important technologies nowadays is artificial intelligence, which is used in robotics, healthcare, agriculture, banking, and many other fields. It is crucial in changing the agricultural industry in the domain of agriculture. The agricultural industry is shielded by artificial intelligence from a number of threats, such as population increase, climate change, food security, and labor shortages in the field. The farming system of today has advanced thanks to machine learning and artificial intelligence. Real-time monitoring, agricultural production, processing, harvesting, and advertising have all been improved by artificial intelligence. Many sophisticated computer-based systems have been created to determine a number of important factors, including harvest quality, weed detection, and yield detection.

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DIFFICULTIES IN AGRICULTURE WITH TRADITIONAL METHODS

The challenges faced during agriculture using the traditional methods are listed below:

1. A number of meteorological variables, including temperature, humidity, and precipitation, are important for agriculture. It can be extremely challenging for farmers to properly harvest, sow seeds, and prepare soil for farming when pollution quickly alters the environment.
2. Fertile soil with adequate levels of essential nutrients like potassium, phosphate, and nitrogen is required for a productive and robust harvest. When vital nutrients are present in the soil but not used effectively, poor quality crops are produced. Nevertheless, it is challenging to assess this soil quality using traditional techniques.
3. During the agricultural life cycle, weeds must be kept away from crops. If not, it can draw nutrients from the soil and raise production expenses. As a result, conventional techniques for weed identification and prevention are ineffective.

AGRICULTURAL PROCESS

The levels involved in lifecycle of agriculture are listed below:

- Soil preparation:
  In the early stages of farming, farmers prepare the soil for sowing. Large clods are broken up and detritus like stones, sticks, and roots are removed during this procedure. In order to provide the best growing conditions for plants, different types of cultivation require different additions of fertilizers and organic materials.

- Sowing seeds:
  At this point, the spacing between the two seeds and the planting depth should be taken into consideration. Temperature, humidity, and precipitation are important meteorological factors during this phase.

- Adding Fertiliser:
  Farmers must maintain soil fertility in order to continue producing wholesome, nutrient-dense crops. Fertilizers, which include phytonutrients like nitrogen (N), potassium (K), and phosphorus (P), are essential to farmers. In agricultural fields, fertilizers are sprayed-on nutrients that supplement the essential elements already present in the soil. The harvest quality is also determined in this process.

- Irrigation:
  This stage aids in keeping soil damp and moisture levels stable. If done incorrectly, overwatering or underwatering can impede crop growth and cause harm to crops.

- Weed Control:

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Unwanted plants that develop near harvests or along the edges of vegetation are called weeds. One of the most important steps is weed control since weeds can degrade crop quality, raise production costs, impact yields, and impede harvest.

- Harvesting:
  It is a technique for gathering field-ripened crops. This is a labor-intensive task that needs a large number of workers. Post-harvest handling, which includes cleaning, chilling, sorting, and storing, is done at this step.

- Storage:
  In this stage of the post-harvest, produce is stored in a manner that ensures food security other than the farming season. This also includes packing and transporting the harvest. (Pravar Jain, Analytics Vidhya, 2021)

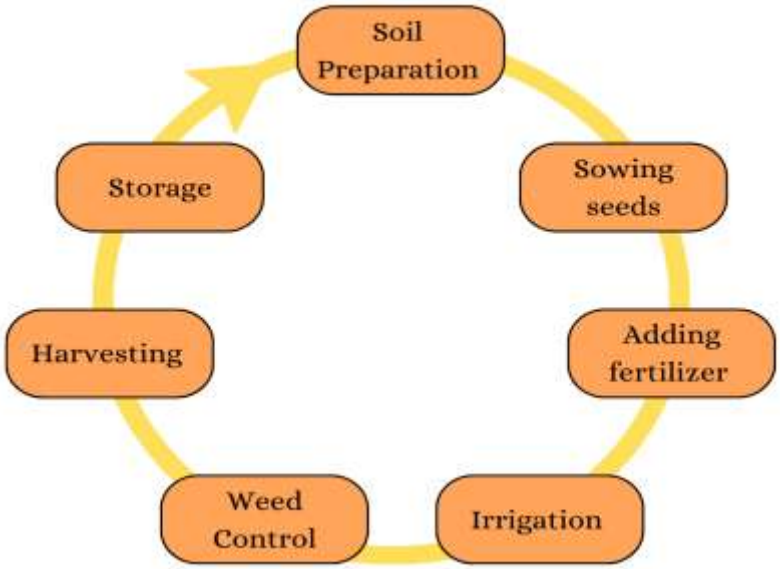

Figure 2. Process of agriculture

APPLICATIONS OF ARTIFICIAL INTELLIGENCE IN AGRICULTUR

Farming by conventional means presents many difficulties for farmers. In this discipline, artificial intelligence is frequently utilized to address these problems. With the use of machine learning and artificial intelligence, industries are able to produce healthier crops, monitor soil and crop growth conditions, control pests, organize farmer data, ease workloads, and carry out a range of agricultural tasks along the food supply chain.

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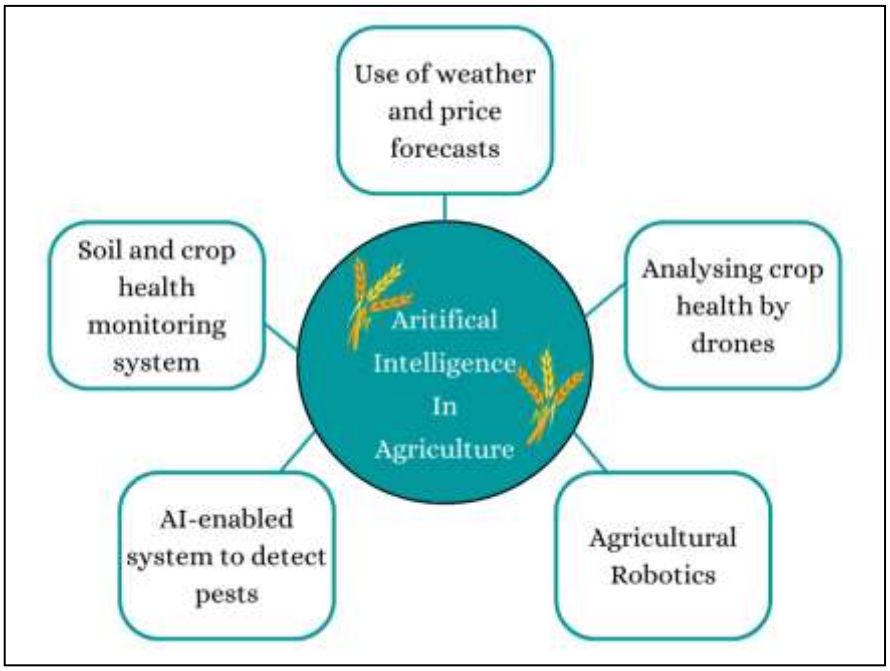

Figure 3. Artificial Intelligence in agriculture

Crop health and soil monitoring system:

Crop quality and variety are significantly influenced by the nutrients and type of soil present. It is difficult to assess how much pollution and deforestation are contributing to the degradation of the soil and crop quality.

Technological start-up established in Germany PEAT developed an artificial intelligence software called "Plantix" that can identify crop diseases and pests in addition to nutrient deficiencies in the soil. This enhances crop quality by educating farmers on the proper use of fertilizers. Technology for picture recognition is used in this application. Farmers use their cellphones to take pictures of their crops. Through a few brief movies, this application also offers instructions and a variety of solutions for soil restoration techniques.

Another machine learning-based business that assists farmers with soil analysis is Trace Genomics. In order to grow healthier and more productive plants, their application aids in crop health and soil monitoring.

Use of weather and price forecasts:

Farmers are finding it increasingly challenging to determine the ideal time to plant seeds due to rising environmental degradation and shifting meteorological conditions. Farmers utilize weather forecasts and artificial intelligence and machine learning to analyze climatic conditions and determine which crops to plant and when to sow. Price forecasting helps farmers maximize their profits by providing them with a more precise image of crop prices in the upcoming weeks.

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Figure 4. Weather forecast for a farmland

Analysing crop health using drones:

Drones are used by SkySquirrel Technologies to provide an aerial image solution for crop health monitoring. This method involves using a drone to gather data from the field, which is then sent from the drone to a computer via a USB drive for expert analysis.

The business analyzes captured photos using a variety of algorithms to produce comprehensive assessments on the state of farms as of late. assisting farmers in identifying bacteria and pests so they can take the required action and provide them the right advice.

These days, tools and applications are created to help farmers practice sustainable agriculture. By giving farmers suitable advise on crop rotation, water management, timely harvesting, types of crops to cultivate, optimal planting, pest infestation, and nutritional management, these artificial intelligence applications in agriculture can assist eliminate errors and mismanagement.

AI-enabled technology analyzes crop sustainability, forecasts weather, and examines data like solar radiation, wind speed, temperature, and rainfall that are used to assess farms for the presence of on-farm pests and diseases and insufficient crop nutrition. These techniques are combined with imagery captured by drones and satellites and machine learning techniques.

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These days, farmers can benefit from artificial intelligence even in the absence of physical connectivity by using basic tools like seeding and farm maintenance apps along with an SMS-enabled phone. Farmers who had access to Wi-Fi may simultaneously utilize the AI application to get ongoing AI-specific plans for their farms and landscapes. With such Internet of Things and Artificial Intelligence-driven solutions can assist farmers meet the worldwide demand for more food by continuously boosting production and income without wasting natural resources.

An artificial intelligence sensor can easily identify weeds and identify the region that the weeds have taken over. If such regions are identified, targeted herbicide applications can be made to minimize herbicide consumption and save time and harvesting. Many artificial intelligence startups are developing computer vision and AI-enabled drones and robots that are capable of precisely spraying weeds. Sprayers with artificial intelligence dramatically reduce the amount of synthetics required in the field, enhancing crop quality and resulting in cost savings.

In the future, farmers will become agricultural engineers thanks to artificial intelligence and machine learning, which will use the data they provide to optimize yields down to the individual rows of crops.

Figure 5. Drones analysing crop health and spraying pesticides

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Agricultural Robotics:

Businesses that specialize in artificial intelligence and machine learning are producing robots that can effortlessly perform a wide range of activities on expansive farms. These robots are ready to battle weeds and harvest an increasing amount of crops faster than people.

These particular robots are programmed to concurrently pick and pack the produce, observe and track the quality of the harvest, and recognize weeds. These robots also address the problems associated with forced labor.

AI-based systems to detect pests:

The worst enemies of farmers when it comes to crop damage are pests. In order to determine whether insects have landed and what kinds of insects—such as locusts, grasshoppers, etc.—it use artificial intelligence techniques to correlate satellite photos with historical data. Employing ML and AI to combat pests and assist farmers eradicate them requires taking the appropriate safety measures and implementing the required pest management measures.

AI START-UPS IN AGRICULTURE

Below are a few instances of well-known startups that used artificial intelligence and machine learning to improve a variety of agricultural aspects:

1. **Fasal:**Throughout the world, more and more people are using artificial intelligence to run their farms. Even still, there are less farms per farmer in impoverished areas than in affluent ones. This is helpful for automated monitoring because it can gather all of the farm data with smaller sensors and less bandwidth. Indian startup Fasal is employed in this industry. Give farmers access to real-time data and insights through the use of AI tools and reasonably priced sensors. Farmers can now take use of up-to-date information about routine field operations. In smaller spaces, it is simpler to set up the company's gadgets. To enable all farmers to practice precision farming, AI-based technologies are being developed.

2. **Prospera:**A 2014 startup established in Israel. The business creates clever methods for efficient farming. The company creates cloud-based technologies that are used to integrate field data—such as aerial, water, and soil photography—with field-based sensors. This gadget, commonly referred to as "Prospera," learns from the information gathered. Several artificial intelligence techniques, technologies, and sensors are used by this device.

3. **Blue River Technology:**In 2011, Blue River Technology was founded in California. This startup is using robotics, computer vision, and artificial intelligence to produce next-generation agricultural equipment. This device makes use of robotics to perform activities, machine learning to determine actions, and computer vision to identify specific plants. Farmers may save money and synthetics by doing this.

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4. **Farmbot:**It is a precision farming machine and open-source CNC software program that enables anyone to produce plants in their own area. The $4000 total cost of the "Farmbot" product enables anyone to perform all aspects of farming themselves, from weed identification to seed planting, with the use of hardware and software. Additionally, it offers a web application that farmers may download on their smartphone or computer system to let them manage their farming from anywhere at any time.

5. **OneSoil:**It's an app designed to assist farmers in making wise choices. For precision farming, the program makes use of computer vision and machine learning techniques. Calculates the ratios of nitrogen, potassium, and phosphate fertilizers, identify field issues, verify weather forecasts, and more while keeping an eye on crops remotely.

BENEFITS OF USING ARTIFICIAL INTELLIGENCE IN AGRICULTURE

1. **Artificial Intelligence provides satisfactory Decisions:**
   Agribusiness can benefit greatly from predictive analytics. By doing this, farmers are better able to handle important agricultural difficulties including analyzing market demand, projecting prices, and determining when to plant and harvest crops. In addition, Artificial Intelligence robots can calculate crop and soil health, monitor weather, offer fertiliser suggestions and even evaluate crop quality. With artificial intelligence in agriculture, farmers will be able to make better decisions and farm more effectively thanks to all these advantages.

2. **Artificial Intelligence saves cost:**
   Farmers may grow more and more plants with less money and resources when they use precision agriculture and artificial intelligence-enabled equipment. Real-time recognition from artificial intelligence helps farmers at every level of farming make better decisions. Making the right choices will help you spend your time and money more wisely and waste fewer goods and chemicals. Furthermore, farmers are able to pinpoint particular areas that require fertilization, irrigation, and pesticide treatment, which minimizes the demand for synthetics during harvest. All of this translates into reduced usage of herbicides, improved crop quality, and increased yields with fewer resources.

3. **Artificial Intelligence alleviates labour shortages:**
   There has always been a labour deficit in agriculture. This issue can be resolved by artificial intelligence through agricultural automation. Farmers won't need to hire more workers since technology and artificial intelligence will help them do their tasks. Self-driving tractors, software for vertical farming, intelligent irrigation and

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fertilization systems, precision farming, intelligent spraying, and AI harvesting robots are a few examples. AI-controlled equipmentand systemsare faster and more precise than human farm workers. (Pravar Jain, Analytics Vidhya, 2021)

CHALLENGES FACED DUE TO ARTIFICIAL INTELLIGENCE IN AGRICULTURE

1. **Unfamiliar with Artificial Intelligence Machines:**
   The majority of people worldwide are not familiar with using AI-enabled products and solutions, despite the fact that employing AI in agriculture has several advantages. In order to address the issue, artificial intelligence businesses should first equip farmers with simple tools and then, as they gain familiarity with them, offer them with sophisticated machinery.

2. **Lack of experience with New Technologies:**
   It may become difficult to integrate emerging technologies, such as artificial intelligence, with agriculture in developing nations. Selling such technology in places where it is not used is extremely difficult. Farmers in these places require assistance from someone to use these tools and procedures.

3. **Security and PrivacyIssues:**
   The use of artificial intelligence is not explicitly governed by any rules or guidelines, which could lead to a number of legal problems. Cyberattacks and data breaches are just two security and privacy problems that can arise from using software and the Internet. For farmers and agricultural owners, any of these concerns could present significant challenges.

ARTIFICIAL INTELLIGENCE IN INDIAN AGRICULTURE

The most prevalent industry in which machine learning and artificial intelligence are productive is agriculture. Crop yields are being increased, agricultural efficiency is rising, and production costs are being decreased thanks to artificial intelligence and Internet of Things sensors that feed algorithms with real-time data. It is anticipated that until 2025, global expenditure on various intelligent agricultural technologies and machinery, including machine learning and artificial intelligence, will increase by three times, to a total of $15.3 billion. According to PwC, the Internet of Things-based agriculture monitoring (IoTAg) market is expected to reach $4.5 billion by 2025, making it the fastest-growing technology area in smart and connected agriculture.

Funds of Rs. 17.563 billion and Rs. 24.227 billion will be given by the Indian government to the state for the introduction of new tools and technologies in agriculture, such as drones, artificial intelligence, remote sensors, block chains, and GIS. Furthermore, the Indian

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Agricultural Research Institute (ICAR) has been given 73.025 billion INR and 79.0818 million INR by the government for the 2020–21 and 2021–22 fiscal years, respectively, to carry out agricultural research and development in order to create new technologies and show them to farmers in order to introduce new technologies.

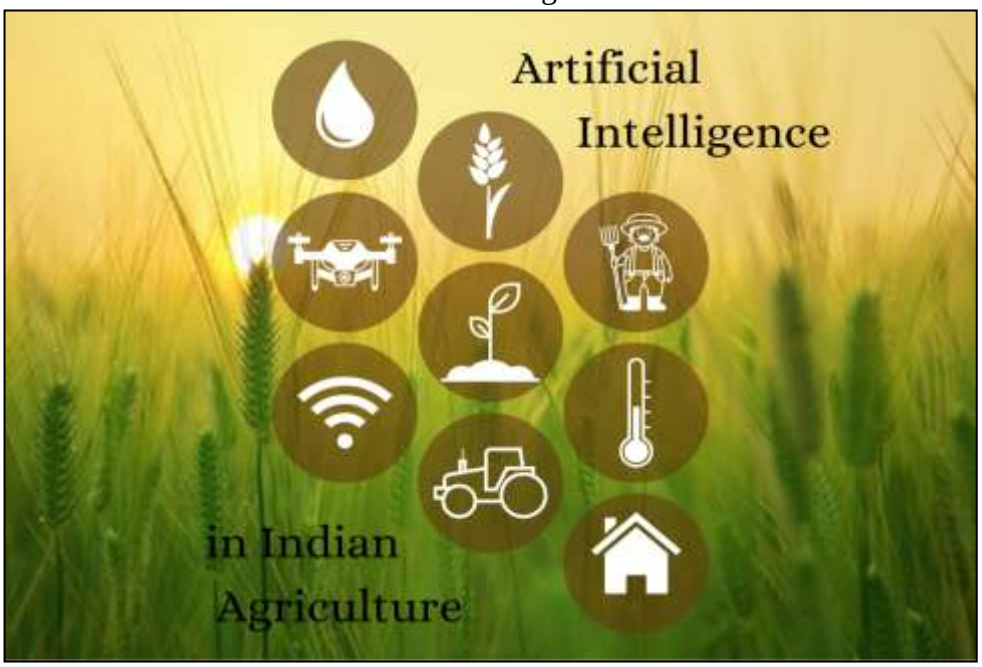

Figure 6.Artificial Intelligence in Indian Agriculture

Apart from enhancing service delivery and facilitating farmers' access to markets, the government is also prioritizing the reduction of transaction costs and empowering farmer-producer organizations (FPO) to strengthen their negotiating position. Building infrastructure to provide stronger ties between agricultural producers, home farmers, and global markets has also received a lot of attention. The crop, horticultural, animal, and fishery varieties and technologies created by ICAR will enhance production and productivity, lower production costs, and boost farmer income. These will also be low-cost, high-yield, disease- and pest-resistant, climate-tolerant crops. Using the ICAR-developed farming system model has helped farmers raise their standard of living and increase their revenues. Additionally, farmers' income will rise because to the State Farmer Income Enhancement Strategy that ICAR offered to the State.

The following are some of the areas where agriculture could benefit most from the incorporation of artificial intelligence:

- Because cognitive computing can interact, learn, and comprehend a variety of environments to maximize output, it has emerged as a revolutionary technology in agriculture. Microsoft has started collaborating with 175 farmers in Andhra Pradesh to offer field, fertilizer, and agriculture-related consultancy services. The effort has raised average production per hectare by 30% over the past year. An agricultural AI application that communicates deadlines, soil preparation, soil test-based fertilization,

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ideal application depth, seed treatment, and more was finished as a prototype project. For non-measurable assets and radiation regions, additional tools include field sensors, mobile agricultural robots, laser scanners, and interdisciplinary cameras.

- Image-Based Precision Agriculture, Internet of Things, Proximity Sensing, and Remote Sensing are related to weather, insect infestation, historical meteorology, soil reports, present research, and drone imagery used for harvest monitoring, field surveys, intelligent data integration, and depth field analysis.

- Image recognition combined with smart algorithms is increasingly being used to diagnose diseases, detect insect infestation, and identify plants and cations. By employing machine learning and artificial intelligence (AI)-based surveillance systems to monitor live video feeds of every crop field, violations by humans and animals can be detected. Immediate alert transmission can be quite beneficial in averting crop loss.

- Yield mapping to identify patterns in bigger datasets and determine them to be orthogonal in irrigation and real-time system optimization to assess the efficiency of frequent irrigation for agricultural planning.

- Due to the current labor shortage, many remote farms are turning to smart AI tractors, agri-bots, and robotics based on artificial intelligence and machine learning as feasible options. The robots reduce labor requirements and operating costs by harvesting quickly, precisely tracing weeds, and performing weeding. These days, chatbots help farmers by responding to their inquiries and offering direction and counsel on particular agricultural and yield-related matters.

- Eliminate obstacles to the sale of safer, fresher commodities and enhance agricultural supply chain tracking and traceability. This will lead to increased supply chain transparency and control as well as a decrease in inventory depletion.

While there are obstacles, the application of artificial intelligence in agriculture shows promise. AI systems require for bigger amount of data to train these robots to produce precise predictions. While gathering spatial data is simple, finding temporary data for vast agricultural regions can be challenging. It takes time to develop strong machine learning models since a robust data infrastructure is required. This is one of the reasons artificial intelligence is used to agronomic items instead of field solutions, such as seeds, fertilizers, and insecticides. The exorbitant cost of the several AI systems available in the agricultural industry is another significant disadvantage. Open source and reasonably priced solutions are necessary to enable even farmers to use these technologies. Through persistent work and

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expandable creativity from the commercial sectors, these technological advancements completely revolutionized agriculture and improved the lives of farmers. (SIRU, 2022)

RESEARCHES IN AGRICULTURE USING ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

1. **IoT driven Application**

   Every day, enormous volumes of organized and unstructured data are produced. Rainfall, ground reports, recent studies, weather patterns, vulnerability to insect infestation, and photos taken by cameras and drones are all included in this data. IoT methods for yield increase detection and intelligent solution provision.

2. **Image based precision agriculture**

   One of the most specialized areas of agriculture in the modern world is precision agriculture. Field scanning, crop monitoring, and thorough field analysis can all benefit from drone imaging. Computer vision, IoT, and drone data combined will enable farmers to take action more quickly. The IBM Watson IoT platform and Visual Recognition API are being adopted by commercial drone manufacturers like Aerialtronics for real-time picture processing applications.

3. **Field management**

   During the agricultural season, real-time estimations are obtained by creating field maps and using high-resolution imagery from drone and helicopter systems to identify the various fields where crops require fertilizer, water, and pesticides.

4. **Disease Detection**

   Getting and analyzing images separates plant leaf images into surface areas, such as background, diseased, and disease-free areas, with high reliability. The affected or diseased region is cut, and samples are submitted to labs for additional testing that can help identify pests and find nutritional deficiencies.

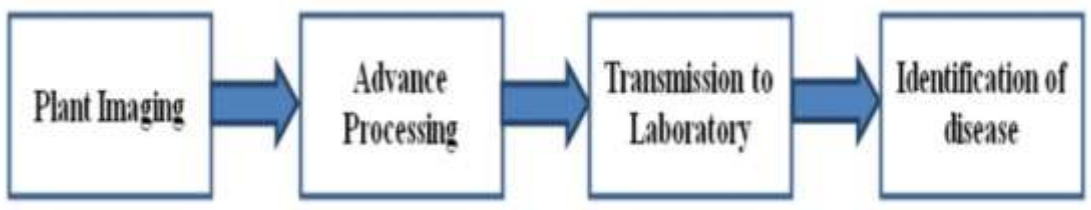

Figure 7.Disease Detection(*"Artificial Intelligence in Agriculture: An Emerging Era of Research", 2019)*

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5. Plant Stress recognition using Artificial Intelligenceand Machine Learning

Utilizing high-resolution images and data from several sensors, Artificial Intelligence can be used to identify different stress levels in plants. The complete dataset, sourced from multiple sources, need to be utilized as input data for models related to artificial intelligence and machine learning. This makes it possible to incorporate particular characteristics for plant stress detection in the compilation of this data. The AI and machine learning model that has been developed has been trained on various plant images and is capable of identifying various levels of crop stress. This whole approach is broken down into distinct processes of detection, classification, analysis and prediction to deliver suitable and enhanced decisions.

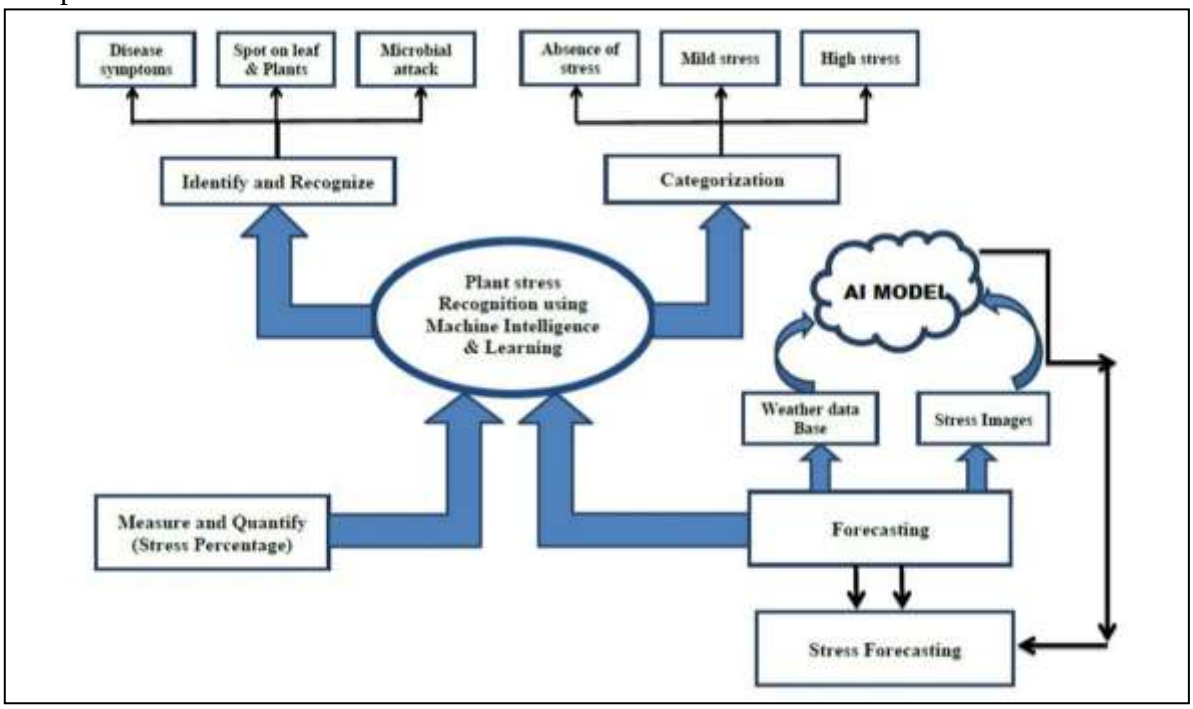

Figure 8.Plant Stress recognition using Artificial Intelligence(*"Artificial Intelligence in Agriculture: An Emerging Era of Research", 2019)*

6. Identification of readiness of crops

A series of images of crops are captured using UVA and white light to assess the ripeness of the green fruits. Using this method, farmers might establish varying readiness ratings for different fruit or crop categories. Add them to sorted batches before putting them on the market.

7. Health monitoring system for crops

Building yield indicators on thousands of acres of farmland requires the use of remote sensing (RS) techniques in addition to hyperspectral imagery and 3D laser scanning. It has the potential to completely transform how farmers tend to their fields in terms of time and labor. Additionally, the full crop life cycle is monitored by this technology, which also generates reports in the event of irregularities.

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8. Calculate the number of agronomic productsused during farming

Based on multiple factors like soil type, weather prediction, seed type, and insect frequency in a certain area, cognitive solutions suggest the ideal crops and hybrid seeds for farmers. customized advice based on the needs of the farm, the environment, and previous successful farming experiences. To assist farmers in making informed decisions, other external considerations such as crop prices, market trends, requirements, consumer needs, and aesthetics can also be taken into account.

9. Robotics in precision agriculture

In order to determine the ideal sowing time for each season, artificial intelligence and machine learning models are employed, along with statistical climate data, real-time Moisture Adequacy Data (MAI) derived from daily precipitation and soil moisture statistics to generate forecast charts and provide farmers with advice on the optimal time to plant.

Microsoft and United Phosphorus Limited are developing an Application Programming Interface (API) for pest risk prediction in order to forecast potential pest attacks. By using artificial intelligence and machine learning, this API provides a strategic advantage in anticipating and warning against impending pest invasions. A high, medium, or low level of pest infestation is anticipated based on the weather and crop growth stage. (Paras M. Khandelwal and Himanshu Chavhan., 2019. "Artificial Intelligence inAgriculture: An Emerging Era of Research" Kavikulguru Institute of Technology andScience.)

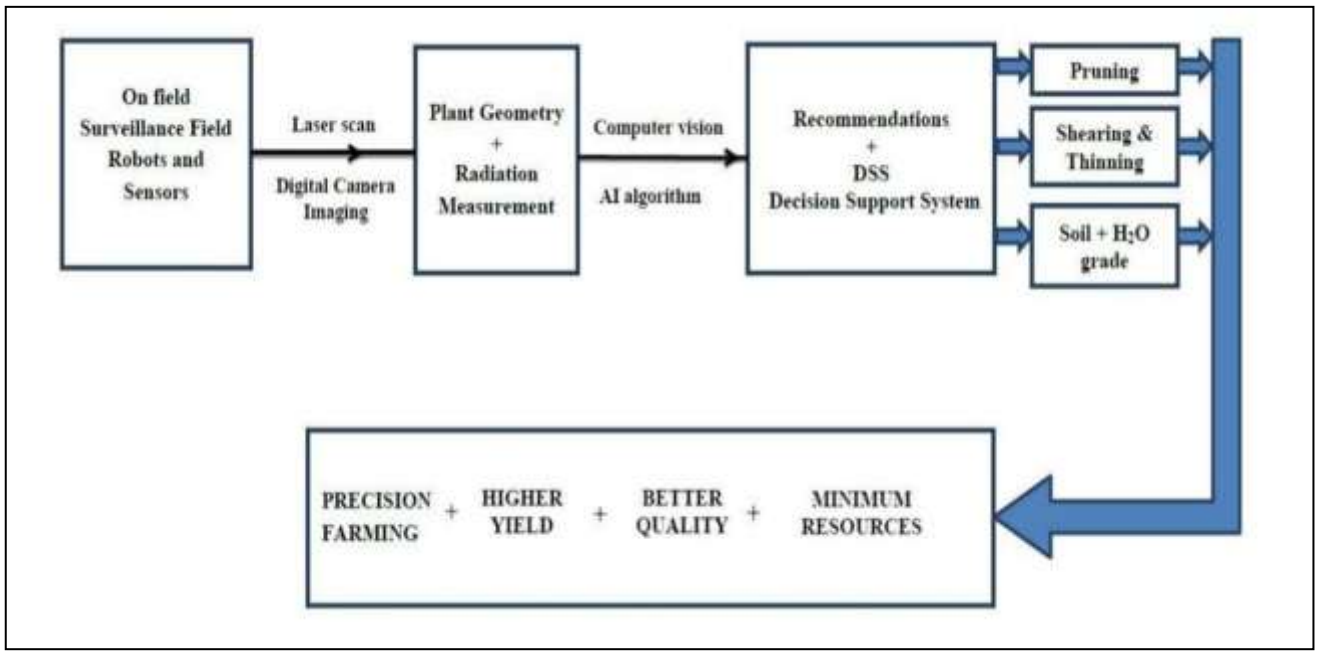

Figure 9.Robotics in precision agriculture("Artificial Intelligence in Agriculture: An Emerging Era of Research", 2019)

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CONCLUSION

Artificial intelligence is making farming more accurate by helping farmers automate their processes and produce larger yields and higher-quality crops with less resource usage.

In the future, businesses will strive to enhance machine learning and artificial intelligence-based products and services like drones, training data for automated system manufacturing, etc. These efforts will progress technology and find more beneficial uses to help the world address challenges associated with food production for a growing population.

REFERENCES

[1] Paras M. Khandelwal and Himanshu Chavhan., 2019. "Artificial Intelligence inAgriculture: An Emerging Era of Research" Kavikulguru Institute of Technology andScience.

[2] Jiali Zha., 2020. "Artificial Intelligence in Agriculture" Journal of Physics: Conference Series 1693 012058, CISAI 2022.

[3] Badia Melis. R et al., 2016. "Artificial neural networks and thermal image for temperatureprediction in apples," Food and Bioprocess Technology, vol. 9 no.7, pp. 1089-1099.

[4] Balleda, K et al., 2014. "Agpest: An efficient rule-based expert system to prevent pestdiseases of rice & wheat crops," in Proc. Intelligent Systems and Control (ISCO)-2014, IEEE.

[5] Hopfield. J. J. 1982. Neural Networks and Physical Systems with Emergent CollectiveComputational Abilities, In: Proceedings of the National Academy of Science of the United States of America, Vol. 79:2554– 2558.

[6] Karmokar B. C., et al., 2015. "Tea leaf diseases recognition using neural networkensemble," International Journal of Computer Applications, vol. 114 no.17, pp. 27-30.

[7] "Rajput, S., Bhatia, K.S. Analyzing handover performance of mobility management protocol using neural network. J Ambient Intell Human Comput (2021). https://doi.org/10.1007/s12652-020-02822-1" .

[8] Kumar, A., Gupta, R., Rajput, S., Bhatia, K.S., Kaur, H. and Gautam, A.K., 2022. Narrow beamwidth conical dielectric resonator antenna. Journal of Optoelectronics and Advanced Materials, 24(March-April 2022), pp.175-186.

[9] Polya.G.2004. How to Solve It: A New Aspect of Mathematical Method, Princeton University Press, New Jersey.

[10] S. Sladojevic, et al., 2016. "Deep neural networks based recognition of plant diseases byleaf image classification," Computational intelligence and neuroscience.

[11] V. Dharmaraj* and C. Vijayanand, "Artificial Intelligence (AI) in Agriculture", International Journal of Current Microbiology and Applied Sciences ISSN: 2319-7706 Volume7 Number 12 (2018).

ISSN PRINT 2319 1775 Online 2320 7876

 Journal Volume 10, Iss 12, 2021

[12] Artificial Intelligence in Agriculture : Using Modern Day AI to Solve Traditional Farming Problems, Pravar Jain (2021) . https://www.analyticsvidhya.com/blog/2020/11/artificial-intelligence-in-agriculture-using-modern-day-ai-to-solve-traditional-farming-problems/

[13] Artificial Intelligence in Indian Agriculture, Strategic Investment Research Unit (2022).https://www.investindia.gov.in/team-india-blogs/artificial-intelligence-indian-agricultureA .

[14] Artificial intelligence in agriculture, Javapointhttps://www.javatpoint.com/artificial-intelligence-in-agriculture#:~:text=AI%20enables%20better%20decision%2Dmaking&text=Moreover%2C%20AI%2Dpowered%20machines%20can,decisions%20and%20do%20efficient%20farming.

[15] Can Artificial Intelligence help improve agricultural productivity? (2017) http://www.fao.org/e-agriculture/news/can-artificial-intelligence-help-improve-agricultural-productivity.

[16] How AI Is Transforming Agriculture, Kathleen Walch (2019) https://www.forbes.com/sites/cognitiveworld/2019/07/05/how-ai-is-transforming-agriculture/#5442e7ad4ad1.

[17] Artificial intelligence in agriculture, Kirtan Jha & Manan Shah (2019) https://www.sciencedirect.com/science/article/pii/S2589721719300182#bbb0025.

[18] How artificial intelligence is helping farmers and babies in the developing world, James Temple (2019) https://www.technologyreview.com/s/613210/how-artificial-intelligence-is-helping-farmers-and-babies-in-the-developing-world/