Preface

The agriculture industry is facing significant challenges in meeting the increasing demand for food while also ensuring sustainable development. Traditional agricultural methods are not equipped to meet the demands of the modern world. To overcome these challenges, Advanced Technologies and AI-Equipped IoT Applications in High-Tech Agriculture provides an in-depth analysis of the opportunities and challenges for AI-powered management tools and IoT-equipped techniques for the high-tech agricultural ecosystem.

Handbook of Research on AI-Equipped IoT Applications in High-Tech Agriculture explores advanced methodologies, models, techniques, technologies, and applications along with the concepts of real-time supporting systems to help agricultural producers adjust plans or schedules for taking care of their farms. Additionally, it discusses the role of IoT technologies and AI applications in agricultural ecosystems and their potential to improve product quality and market competitiveness. The book includes discussions on the application of blockchain, biotechnology, drones, robotics, data analytics, and visualization in high-tech agriculture. It is an essential reference for anyone interested in the future of high-tech agriculture, including agricultural analysts, investment analysts, scholars, researchers, academics, professionals, engineers, and students.

This book aims to delve into the advanced technologies and AI-equipped IoT applications that are shaping the agriculture industry. It will explore the potential, challenges, and opportunities that arise from this integration, ultimately envisioning the future prospects and implications of AI and IoT technologies in the era of the High-tech Agriculture.

There are many advancement technologies and AI-equipped IoT applications discussed below.

To bring the concepts and models of advanced technologies and AI-equipped IoT applications in high-tech agriculture to readers on the world, the following topics will be introduced in this book.

Chapter 1. Revolutionizing Agriculture: Exploring Advanced Technologies for Plant Protection in the Agriculture Sector

In today's rapidly evolving world, the agriculture industry stands at the threshold of a revolutionary transformation. With the increasing demand for food production and the challenges posed by climate change, agricultural firms are exploring innovative technologies to revolutionize the way we protect our crops. Advanced technologies have emerged as a beacon of hope, offering promising solutions to mitigate risks and enhance plant protection in the agricultural sector.

This chapter delves into the exploration of cutting-edge technologies that are revolutionizing agriculture, focusing specifically on plant protection. By harnessing the power of advanced technologies, agricultural firms can not only safeguard their crops from pests, diseases, and environmental factors but also enhance productivity and optimize resource utilization. These technologies have the potential to reshape traditional agricultural practices, providing sustainable solutions for a rapidly growing global population.

Furthermore, the integration of Internet of Things (IoT) devices and sensors in agricultural operations enables real-time monitoring and data-driven decision-making. Soil moisture sensors, weather stations, and automated irrigation systems work in tandem to maintain optimal growing conditions and ensure efficient water usage. By leveraging this interconnected network of devices, farmers can detect anomalies, predict pest outbreaks, and take preventive measures, thereby reducing the reliance on chemical pesticides.

In addition to these breakthrough technologies, machine learning and artificial intelligence have emerged as indispensable tools for analyzing vast amounts of agricultural data. By employing algorithms and predictive models, farmers can gain valuable insights into crop performance, disease patterns, and pest behavior. This information empowers them to implement proactive measures, optimize treatment strategies, and make accurate predictions, ultimately maximizing crop yields and profitability.

Chapter 2. AI-Driven Applications in High-Tech Agriculture

In light of the growing global population and the ensuing rise in food consumption, a deep exploration of inventive and innovative artificial intelligence (AI) technologies is needed to support agricultural industry meet the food supply needs globally. Artificial intelligence (AI) has a substantial impact on resource optimization, waste reduction, and improvement of sustainable farming practices.

AI-driven systems can be developed to holistically monitor farming practices at a micro granular level, identifying regions of stress, disease, or nutritional deficits, by utilizing technology like satellite imaging, drones, and IoT sensors. As a result, the total environmental impact on farming can be reduced and resources can be used effectively through focused interventions like spot spraying or localized fertilization.

AI-driven processes are revolutionizing high-tech agriculture by enhancing efficiency, precision, and productivity across various aspects of farming. With the power of artificial intelligence, farmers can leverage advanced technologies and data-driven approaches to optimize operations, improve decision-making, and achieve sustainable agricultural practices.

The goal of this chapter is to raise awareness of the critical role that high-tech agriculture plays in supplying the world's ever-growing food demand and ensuring food security. The main goal is to investigate how AI technologies could improve agricultural productivity and efficiency. Also, to successfully address the pressing challenges the agriculture sector is currently facing, such as resource limitations, the impacts of climate change, and escalating food demands.

The chapter offers a thorough overview of the function of AI-driven applications in high-tech agriculture by highlighting the possible advantages and posing questions, while emphasizing the significance of sustainable implementation and supportive legislative frameworks for equitable growth and development.

Chapter 3. AI-Equipped IoT Applications in High-Tech Agriculture Using Machine Learning (ML)

Agriculture is a fundamental sector that feeds the world's population, and as such, it plays a critical role in the global economy. Over the years, advancements in technology have transformed the agricultural landscape, with farmers using smart technologies to increase productivity and efficiency.

One such technology is the Internet of Things (IoT), which involves the use of sensors, devices, and software to collect and exchange data. When combined with artificial intelligence (AI) and machine learning (ML), IoT can create high-tech agriculture systems that optimize farming practices and crop yields while reducing environmental impact.

AI-equipped IoT applications in agriculture can perform a range of functions, including crop monitoring, soil health monitoring, environmental monitoring, crop prediction, yield forecasting, irrigation management, pest management, disease detection, and plant phenotyping. This technology can help farmers make more informed decisions and respond quickly to changing conditions, ultimately increasing efficiency and profitability while reducing costs and environmental impact.

In this context, this article will explore the potential of AI-equipped IoT applications in high-tech agriculture, using machine learning algorithms to revolutionize the way we produce and consume food.

AI-equipped IoT technology can also help farmers protect their crops from animal raids. Human-wildlife conflict is a growing issue as habitats continue to shrink, and animals encroach on farmland. Animal detection technology, powered by machine learning algorithms, can accurately identify the species of animals that enter farmland and alert farmers of the potential threat. This can help farmers take preventive measures, such as setting up deterrents, or even deploying non-lethal animal repelling technologies.

With the help of AI and machine learning, farmers can more effectively manage human-wildlife conflict and protect their crops from damage. Overall, the combination of AI, IoT, and machine learning has the potential to revolutionize the agricultural industry, making it more efficient, sustainable, and environmentally friendly.

Chapter 4. Appropriate Technologies and Its Implications in the Agricultural Sector

Technology is an idea or knowledge which can be applied to discover or create new goods and services in manufacturing sector or other production activities. Technology helps to increase productivity, efficiency, and effectiveness of existing resources. It is a systematic and practical knowledge that is based on experiments of scientific theory and it has practical implications in production activities. It enhances invention and innovation to produce innovative goods and services to satisfy the human needs and improve livelihood security.

Environmentally friendly technology is associated with use of renewable resources such as attain energy from the sun, wind, and water. Social and economic viability of technology includes the social and economic components of individual person or household or firm. For instance, any method, way, process and technology which are supportive to receive energy from sun, wind and water without harming the environment known as AT.

AT have provided several options to enhance the growth of agricultural sector in many countries. AT is useful to maintain quality and durability of final crop, to reduce bacteria in products as per human requirements. Farmers can also improve productivity and efficiency of inputs as using AT and technological advancement in the cultivation.

Agricultural technology has a positive impact on smallholder's income, create jobs and maintain environmental sustainability. In aforementioned perspective, several studies have described the conceptual review on significance of AT, science & technology and technological advancement in the agriculture sector.

Chapter 5. Applications of Drones in High-Tech Agriculture

A drone, also known as an unmanned aerial vehicle (UAV), is a type of aircraft that operates without a human pilot onboard. Drones are typically remotely controlled, either by a pilot operating the drone from a ground station or via a pre-programmed mission.

Drones can also operate autonomously using artificial intelligence algorithms and computer vision systems that allow them to navigate and perform tasks without human intervention. Drones are equipped with a range of sensors, cameras, and other devices that allow them to gather data and images from the air. This data can include information about temperature, humidity, wind speed, air pressure, and other environmental conditions, as well as high-resolution images and video footage.

Drones are a versatile and powerful technology that is transforming a wide range of industries and applications. As drone technology continues to evolve and improve, their capabilities and applications are likely to expand even further.

Drones, have found numerous applications across various sectors. Their versatility, maneuverability, and ability to capture high-resolution images and videos from unique perspectives have made them valuable tools in different industries. Here are examples of the many applications and how drones are used in various sectors. As technology continues to advance, drones are likely to play an even larger role in various industries, improving efficiency, safety, and data collection capabilities are some examples of how drones are used in various sectors.

Chapter 6. Unmanned Aerial Vehicles (UAVs) in Modern Agriculture: Advancements and Benefits

It's very difficult for you to check out any sector of the economy without noticing the use of drones. Drones are employed in the agricultural industry for a wide range of duties, including spraying fertilizer, aerial surveillance, crop monitoring, land inspection, mapping, looking for damaged or rotting crops, and many others.

The potential of different drone types in farming, agriculture, and gardening is being investigated. Drones like quad copters are the greatest option for crop fertilization because of their multi-rotor design. The massive construction of fixed-wing drones, which requires a large landing area, makes them impractical

Drones' great ability to evaluate, diagnose, and survey crops for any deficiencies is another fantastic benefit of employing them to fertilize crops. Their laser-equipped sensors and high-resolution cameras help with the quick completion of a variety of activities. These defects are also mapped in real-time by unmanned aerial vehicles, and crop management decisions can be made using the data that is gathered and processed.

Drones are already being used to check claims in agricultural insurance surveys. These benefits make drones a strong contender for improving agricultural practices at a low cost. Optimizing the use of water, pesticides, and fertilizers in critical areas has numerous ecological and environmental advantages in addition to financial gains that are not otherwise possible.

Chapter 7. Robotic Innovations in Agriculture: Maximizing Production and Sustainability

The agricultural sector plays a vital role in providing food for the global population through a range of practices in the agri-food chain, encompassing primary tasks such as soil plowing, sowing, spraying, weeding, harvesting, pumping, and drying, as well as secondary operations like storing and packaging.

The integration of electronics and computing technologies has had a significant impact on agriculture. Modern agricultural machinery utilizes sensors and high-speed computers to optimize the application of crop inputs, including seeds, fertilizers, and chemicals, as well as facilitate the transfer of bio materials such as grain and biomass from fields to processing facilities.

Worldwide, automated conventional machinery and agricultural robots (agri-robots) are seen as key solutions for performing precise, efficient field operations (e.g., planting, fertilizer spreading, spraying, weed management, and harvesting) to increase productivity while reducing environmental impacts. In Asian countries like China, Japan, Sri Lanka, Nepal, India and Pakistan, the increasing average age of farmers and the migration of the younger generation to developing large cities are driving the demand for agricultural machine automation.

The increasing need for productivity gains, emerging demand for organic crops, and the impending obligation to transform agriculture into a sustainable and environment-friendly practice are some of the major driving forces for the research, development, and adoption of highly automated systems and agri-robots. Economic feasibility, socioeconomics, and the liability aspects of agri-robots have to be addressed before they can be fully realizable in agricultural production.

Chapter 8. Advanced Technologies and AI-Enabled IoT Applications in High-Tech Agriculture

Agriculture is a vital sector that supports the world's growing population and provides essential resources for our daily lives. However, traditional farming practices are increasingly unsustainable due to population growth, climate change, and resource constraints. To address these challenges, a novel approach has emerged that leverages advanced technologies and AI-enabled IoT applications in high-tech agriculture.

This approach combines the power of artificial intelligence, the internet of things, and precision agriculture techniques to optimize crop production, reduce environmental impacts, and enhance resource management. By incorporating sensors, drones, robotics, and machine learning algorithms, farmers can obtain real-time data on soil moisture, temperature, humidity, and other key parameters, allowing them to make informed decisions on irrigation, fertilization, and pest management.

This approach has enormous potential to revolutionize traditional farming practices and enable farmers to achieve higher yields, better crop quality, and improved profitability. This article will explore the benefits and future scope of using advanced technologies and AI-enabled IoT applications in high-tech agriculture in not only India country but also in another country in the world.

Chapter 9. GUI-Based End-to-End Deep Learning Model for Corn Leaf Disease Classification

Food Security indicates the availability of food at all times and the accessibility of individuals to it. According to an article published in 'Agronomy'- factors that influence crop yield and hence food security can be grouped into three categories namely technological, biological and environmental. The amount of influence of each of these factors on crop production again varies based on region to region and crop to crop.

In these factors plant diseases make up a major part of the biological group with pests, weeds and insects. It is estimated by FAO that annually the loss due to pests is up to 40% of global crop production. Every year, the global economy is affected by over $220 billion due to plant diseases and a minimum of $70 billion due to invasive insects. Especially in a highly populated country like India, which is one of the largest producers of most food crops around the world, the threat to food security is even more imminent. Hence it is imperative that new and better methods to identify plant diseases are explored.

Deep Learning, a subset of machine learning, is in use across the various industries ranging from driving to medical devices. Deep learning at its root is a neural network with layers. These layers attempt to replicate the neural functioning of the human brain to enable it to process and learn from large amounts of data.

One of the key recompenses of using deep learning algorithms apart from the large amounts of data it can work with is the kind of data it can work with. Deep Learning algorithms canister progress unstructured data, for example text and images. It mechanizes feature extraction reducing the involvement of humans and also performs pattern analysis and data classification.

The traditional methods of detecting plant diseases involve visual inspection and later detailed detection in the laboratory. This process is both time-consuming and accessible to farmers from different economic backgrounds, such as B. small farmers, not accessible. This involves the development of automated and intelligent illness detection systems that deliver faster findings and are more accessible through the use of diverse technologies such as artificial intelligence, machine learning, and deep learning. Deep learning techniques gather features from pictures and then utilize these functions to conduct classification or regression as needed.

Chapter 10. Leaf Disease Detection Using Machine Learning (ML)

"Leaf recognition" is the method of recognizing patterns in leaves using image processing. Image processing is a method for converting a physical image to a digital one so that you can edit, add to, or remove information from it. A leaf is classified as "known" or "unknown" after being compared to previously store known leaves. The leaf image can be quickly transferred to a computer, which can then automatically extract features using image processing methods.

A video frame or photograph serves as the input for this type of signal distribution, and the output might either be another image or attributes associated to that image. Typical image processing systems process images using well-known signal processing techniques and treat them as two-dimensional signals. The standard method of classifying leaves involves two main steps.

Having a priori knowledge of each class that has to be recognized is the first stage. This knowledge often includes some texture feature sets from one or more classes. The second phase involves using classification techniques, such as nearest neighbors and decision trees, after knowledge is accessible and texture features of the observed image are retrieved.

Many different texture feature extraction techniques are currently available, and most of them involve tenable parameters. Finding the best feature extraction is challenging. The main idea behind this approach is to create features using grey level co-occurrence matrices (GLCM). The co-occurrence of spatial interactions between pixels is measured by the matrices.

Chapter 11. Smart Agriculture Using a Soil Monitoring System

The world's population is projected to increase dramatically by 2050, reaching 8.7 billion people, up from 6.9 billion in 2016. People are adding more protein to their diets as a result of an increase in wealth. According to a study from the United Nations' Food and Agriculture Organization (FAO), agriculturists should boost their output by 65% above present levels.

To feed the expanding global population, food producers must increase their output. The demand for food will rise by about 50% as compared to 2013 with the population increase. Urbanization growth is predicted to increase another 2.4 billion people live in urban areas. Even if there is a growing need for food, growing urbanization reduces the number of people residing in village regions, which results in a shrinking agricultural workforce.

In addition, rural residents are quickly ageing, which will result in a severe manpower shortage in the future. The world's agriculture is becoming unsustainable as a result of population development and urbanization, and 25% of the world's arable land is already damaged. Nearly 40% of the world's rural population experiences water shortages, indicating that water resources are already at an extreme level of use. To increase production, unbalanced fertilizers are utilized, which affects the amount of soil nutrients.

The major soil nutrients are nitrogen (N), phosphorus (P), and potassium (K), whereas iron, manganese, zinc, boron, and chlorine are the insignificant ones. The development of the plant and excellent yields depend on the proper balance of these nutrients. Amino acids are produced by macronutrients like nitrogen, whereas phosphorus and potassium aid in the development of plant growths, photosynthesis, and disease resistance. Due to improper irrigation timing and unbalanced fertilizer application without knowledge of a certain crop's real nutritional needs, soil fertility is reduced.

With advancements in science and technology, agriculture's traditional methods are changing. Technology in agriculture advances, responds to customers' genuine needs, and maintains the balance between supply and demand for food. Because of the advancements in automation like sensors, gadgets, equipment, information technologies, and quick transmission networks, modern farms and agricultural operations operate differently. Robots, sensors, aerial photographs, and GPS technology are all used.

Modern technology helps farmers to utilize water, fertilizers, and other resources efficiently. The efficiency and production of agriculture are predicted to rise with technological advancements as larger and miniature farmlands are closing and becoming more integrated in comparison with earlier years. Data collection is crucial for identifying trends, and it is anticipated that there would be 4 million more data points than on a typical farm.

The IoT enables the analysis of both structured and unstructured data to provide additional information about food production. IoT platforms are converting agricultural frameworks into true AI frameworks by using machine learning, AI, etc. to data from field sensors. Farmers may make better judgments by studying and connecting data on the weather, seeds, soil, disease likelihood, and insect assaults.

Chapter 12. Computer Intelligence-Based Fruit Grading

Due to India's varied environment, various fresh fruits and vegetables are always available. After China, it produces the most fruits and vegetables worldwide. According to the National Horticulture Board's National Horticulture Database (@3rd Advance Estimates), total horticulture production is expected to reach 342.33 million tons in 2021-22, which is 7.73 million tones (or 2.3% more) than in 2020-21 (final).

Providing good quality food to a person is a crucial task of testing in the current mechanical era. It is imaginable to analyze the fruit's quality; nonetheless, this review requires a lot of work. A programmed fruit-evaluating framework is needed to complete this assignment for quality and sustenance. The structure for planned fruit reviews is also crucial. By recognizing innovation without endangering the fruit, the non-dangerous automatic quality method helps to discern the type of fruit. Due to poor technique, currently, it might be challenging to determine the sort of fruit from its color, shape, and size.

Computational expertise and machine learning (ML) techniques were used to pass this test, and they successfully identified the types of fruits. The number of farm workers in the fruit business is steadily declining daily. Adopting labor-saving technology is crucial as a result. The best method for fruit identification is image processing, which also makes packaging and sorting easier. Once more, to determine the fruits' right market worth, their size, and quality must be quantified. Fruit quality inspection can only be done manually by feeling and looking, which is impacted by numerous factors such as inconsistent and erratic decision-making.

Chapter 13. Automatic Irrigation System Using Solar Tracking Device

This project is based on solar system and electricity. We may operate in agriculture with sunlight. The people who work in agriculture will benefit from this achievement. Solar tracker is the use of solar panels. Its unique feature is that wherever the sun moves, the solar panel automatically faces the sun to track solar energy.

Electricity is created using this solar energy. These electrical energies will be used by the engine to drive the water pump in and out. In order to generate through the sprinklers, water is therefore pumped out of a well or any other lake, etc. following the motor. All agricultural areas will receive water through sprinklers. This system is referred to as solar tracker irrigation.

The photovoltaic system can power the pump. The solar system's and the photovoltaic panels' right angles is maintained by a microcontroller system that tracks the sun's location. The development of an autonomous watering system using photovoltaic panels is the major goal of the effort. In order so as to run the water pump and keep the optimal watering conditions in place.

Irrigation systems are those that distribute aqua to the main places. How well the irrigation worked will depend on system chosen. Agriculture was essential to supporting life on Earth since ancient times. The tool for improving agriculture will be the type of irrigation system used. Around the world, there are many different kinds of irrigation systems in use, and each one has encountered issues in some way. There are actually just a handful contemporary irrigation systems in use, and they almost always fall short in some way.

Engineers are working to develop integrated automated devices in order to create complex systems that aid humans in their activities so the system can function automatically without human intervention. Automation in the irrigation industry will play a significant role. The alternate solution in this kind of circumstance is an automation irrigation process using solar tracking. The global agricultural system relies on water in the soil and is constantly in need of improvement.

Chapter 14. Exploring the Challenges and Adoption Hurdles of Blockchain Technology in Agri-Food Supply Chain

The agricultural sector has been the backbone of India's economy, with India being one of the major producers of agri-produce. The agri-food supply chain is a crucial aspect that connects the players involved in the procurement, collection, sourcing, distribution, manufacturing, production, wholesale, retailing, and finally reaching the consumers.

The supply chain has become more organized globally and is well interconnected, resulting in a vast amount of documentation of data being carried out in physical paper format or digital storage. However, the food industry faces a growing concern of food fraud, where there is a purposeful replacement, addition, tinkering, or falsification of food products, ingredients, or packaging for commercial advantage. Studies show that food fraud costs the world economy at least $65 billion (Johnson, 2018). With a significant rise in the volume and types of food fraud seen in 2018, food experts have dubbed 2018 the year of food fraud and fraud preventive actions, as fake cherries, honey, rice, wine, fish, and other items were discovered.

Blockchain technology has shown promise in several fields, including agriculture, due to its distributed nature, encryption, transparency, and timestamped measurements. As a result, it is thought to be one of the most secure data structures for large data and a further effective method for determining food authenticity. Integrating serialization with blockchain could provide a reliable solution to counterfeit labeling challenges in the global food industry, but its adoption rate will be a crucial factor. Several attempts have been made to use blockchain for competitive landscape traceability, farmer positioning, and logistic support, penetrating new markets, and trading costs in the food sector, as found in a review of existing literature on food sector periodicals.

The management of information in the agri-food distribution chain can be achieved through either a private or government database. However, the ownership and accessibility of such databases may pose a risk to the confidentiality of business data, as third parties or members of the public could potentially gain access to crucial information. In industries where data security is of utmost concern, the protection of digital assets is a priority, even in the era of digital transformation.

Blockchain technology has revolutionized record-keeping and facilitated the transition of crucial data to a more efficient database management system. Despite gaining widespread acceptance, the agri-food supply chain has been slow to adopt this technology. The Blockchain Supply Chain Market is expected to grow by 81.7% from 2021 to 2026, driven by increasing demand for transparency and security. Barriers to implementation are examined in this research paper, which proposes solutions for a more sustainable system that prioritizes data-driven decision making and food safety.

Chapter 15. Applications of Sensors in High-Tech Agriculture

In recent years, the field of agriculture has witnessed a rapid transformation driven by advancements in technology. One of the key components fueling this revolution is the integration of sensors into agricultural practices. Sensors are devices capable of detecting and measuring physical, chemical, or biological variables and converting them into electrical signals. These signals provide valuable data that can be used to monitor and optimize various aspects of crop production, livestock management, and environmental conditions.

In this chapter the applications of sensors in high-tech agriculture is discussed. It explores the diverse range of sensors utilized in modern farming techniques and their impact on increasing efficiency, productivity, and sustainability in agricultural practices. By harnessing the power of sensors, farmers can make informed decisions based on real-time data, leading to better resource management, improved crop quality, and enhanced yields.

The applications of sensors in precision agriculture play a crucial role in gathering accurate and timely information about the variables that affect crop growth and yield. By utilizing sensors in high-tech agriculture, farmers can monitor and control critical factors, leading to enhanced resource management, improved crop quality, and increased productivity.

By continuously monitoring these parameters, farmers can precisely manage irrigation and fertilizer application, ensuring that crops receive the optimal amount of water and nutrients. This leads to improved water use efficiency, reduced nutrient runoff, and enhanced crop health and yield. In summary, precision agriculture leverages the applications of sensors in high-tech agriculture to collect real-time data on various parameters.

In high-tech agriculture, sensors are used to collect data from the environment and crops. This data can be used to monitor and optimize various aspects of agricultural operations such as irrigation, fertilization, and pest management. Sensors can help farmers to make informed decisions about the use of resources such as water and fertilizer, resulting in higher yields and more efficient use of resources.

Chapter 16. Revolutionizing Agriculture Through Blockchain: A Bibliometric Analysis of Emerging Trends and Applications

India is prevalently an agrarian country, with the greater part of the populace depending on agriculture as their fundamental kind of revenue. 60% of the land region in the country is utilized for farming, which produces around 16% of the Gross domestic product generally. Since it utilizes half individuals, the farming area is crucial for the development of the economy. Indian agriculture has consistently assumed a huge part in worldwide business and has been a critical supplier of rural and related merchandise.

While agribusiness' extent of the Indian economy has progressively dropped to under 15% because of the quick ascent of the modern and administrative areas, the area's significance in India's financial and social texture stretches out a long way past this measurement. First of all, north of 3/4 of Indian families depend on basic pay. Second, most of India's poor (around 770 million individuals, or around 70%) live in rural areas.

Third, India's food security is reliant upon extending the result of crops as well as natural products, vegetables, and milk to satisfy the requests of a developing population with rising wages. To achieve this, a rural industry that is useful, serious, different, and economical should arise quickly. India is a farming based country to be reckoned with on a worldwide scale. It is the world's most prominent maker of milk, pulses, and spices, as well as the biggest cow group (bison) and the biggest region under wheat, rice, and cotton development. It positions second in the development of rice, wheat, cotton, sugarcane, cultivated fish, sheep and goat meat, natural products, vegetables, and tea. The nation has around 195 million ha under farming, with roughly 63% being rainfed (almost 125 million ha) and 37 percent being flooded (70m ha).

Equal compensation for farmers and fair exchanging of merchandise are two last problematic issues that should be tended to after some time. In short, there are as yet unsettled hardships in agriculture connected with creation supportability, fair compensation for makers, item discernibility and observing, and different issues. Data sets are currently following information and overseeing data streams using ICT (information and communication technology). It is a new plan to utilize blockchain innovation to control these data sets.

Chapter 17. An Application of Magnetic and Geochemical Techniques to Determine Pollution Load in Leafy Vegetables in Industrial Area Proximity

Industrial, agricultural and municipal effluent discharges to the marine environment continue to be a significant environmental concern because of the chemicals present in the environment. It is well known that growing and diversifying chemical industry, enhance the risk of environmental pollution by the increasing distribution of chemicals in the environment. Although chemicals have contributed a great benefit to our modern society. Chemicals have also contributed to the adverse impacts on the ecosystems at local, regional and global levels.

Effective effluent quality monitoring includes evaluating preventative measures, based on the identification of possible human health hazards, and in preventing the degradation of the aquatic environment. Pollution caused by HMs in environment is of great concern to public health. The source of HMs in plants that grow through their growth medium (soil) was reported recently.

Plants grown in polluted environment may accumulate HMs to a high concentration. This may result serious adverse effects on human health on consumption. Moreover, HMs have a limited useful concentration window. On a lower side, HMs result in deficiency and on the other hand, they are toxic because they tend to bio-accumulate in plants and animals, bio-concentrate in food chains. HMs are specific to various organs in the body.

Many factors such as nature of soil and water, climate, atmosphere deposition and plant morphology influence uptake and accumulation of HMs in vegetables. For Environmental monitoring various plant samples have been used as bio-indicators. Assessment of the elemental composition of leaves is one of the most frequently used methods for monitoring effect of environmental pollution.

Vegetables are known to take up metals by absorbing them from growth medium like soil and water. It is also possible that air born particulate matter could be deposited on different parts of the vegetables from polluted environments. Uptake and translocation of various heavy metals depend on their oxidation state and species. Observed differences are attributed to soil treatments as a function of Fe and other pollutants during the growth period of plants. Consequent upon, some studies examined the effects of environmental pollution on chemical and magnetic properties of soil and plant biomass and are related to bio-monitoring of air quality.

Chapter 18. Role of Photochemical Reactions in the Treatment of Water Used in the High-Tech Agriculture

Pollution of water bodies with toxic organic substances has recently been considered a global environmental issue, and therefore it is important to develop new methods to solve the problem. In modern times, heterogeneous photocatalytic methods are considered to be the most effective methods in protecting the environment and removing phenol-type compounds from wastewater. On the other hand, due to the development of nanotechnology, the processes involving nanoparticles are very interesting and new.

In this case, it is considered environmentally friendly because of the very small amount of substances consumed. In this regard, in modern times, effective cleaning methods using nanoparticles are becoming more widespread. Looking at the world literature, in recent years there have been many methods of effective cleaning based on Nano-composites. For example, GO/Al2O3 Nano-composite was prepared by spin-closing method for effective removal of phenol from wastewater, and it was possible to remove phenolic organic compounds from wastewater with 99.9% on the basis of composite.

Phenol is always found in wastewater because it is obtained from petrochemicals, pharmaceuticals, plastics, coal, paints and paper. In general, phenol is one of the most important hazardous pollutants due to its low biological decomposition, high concentrations and high toxicity in terms of long-term harmful effects on the environment. The gradual reduction of fresh water and the increase in pollution are already important environmental problems in the world.

Chapter 19. Predictive Analytics for High-Tech Agriculture

Artificial intelligence (AI) tools like machine vision, natural language processing, expert systems and speech recognition have altered both the quantity and quality of work in the agricultural sector as a result of the growing global population, the increasing demand for food, as well as changes in weather and the availability of water.

Agriculture carries greater risk than nearly any other sector. In agriculture, the proverb "you harvest what you sow" is not necessarily true. Because there is so much going on at the farm, it is very challenging for farmers to concentrate on all the everyday concerns such as weather, crop disease, commodity pricing, and fertilization schedules.

In order to fulfil these rising needs, farmers must also produce more food with the limited water and land resources available due to the growing global population and food consumption. There will be a huge increase in the number of people to feed in thirty years, thus agricultural methods must change to match the need.

Chapter 20. Futuristic Technologies in Agriculture Challenges and Future Prospects

Federated learning, a machine learning technique, enables numerous individuals to collaborate on developing a common model without sharing any of their personal data. This is a rapidly evolving field with immense potential for application in various domains health care, cloud computing, edge computing, security, data security, cyber security, IoT and agriculture etc.

This chapter is focused on the benefits of federated learning in agriculture domain including precision farming, disease diagnosis, UAVs, and the Internet of Agriculture Things, there is still much to explore in terms of its full potential in these areas. This strategy has enormous promise in agriculture, where privacy concerns might restrict stakeholders' sharing of important information.

Federated Learning enables farmers, academics, and other stakeholders to collaborate on the development of more precise crop production, waste reduction, and sustainable agriculture models. The ability to compile and analyze data from numerous sources without violating privacy is only one of its many advantages. Farmers may keep their data secure while gaining from the knowledge and experience of others by using federated learning.

Also, researchers have access to a greater variety of data, which results in models that are more precise and reliable. Federated Learning has the ability to fundamentally alter how we think about agriculture by allowing us to develop more precise and long-lasting models without jeopardizing privacy.

With the ability to build shared models without compromising privacy, Federated Learning opens up new possibilities for collaboration between farmers, researchers, and other stakeholders. By allowing parties to train models on their private data and share only the model parameters, Federated Learning enables the creation of more precise and long-lasting models.

Chapter 21. Future of Smart Agriculture Techniques and Applications

Future solutions include artificial intelligence (AI) and machine learning. The two forms of AI—narrow and general—are distinct. Software that performs linear tasks is referred to as narrow AI and is often used in conjunction with hardware and sensor systems. An autonomous farm vehicle, like a driverless tractor, is something you find to employ a particular AI in agriculture. The second kind of AI is general AI.

We are highly clever, capable creatures that are aware of ourselves. For tracking crops in domains like pesticide tracking, farmers are hiring data companies employing AI. The productivity of farmers may be increased by using robots that have human qualities like speech recognition and decision-making. Examples of AI now being utilized in agriculture include robots that can manage water, clean the ground, plant seeds, and pick crops. The issue for the future is: how will we go with AI in agriculture?

The foundation of every sustainable economy is farming. However, it may differ throughout nations and be a crucial factor in structural change and long-term economic success. Producing food and crops was formerly the only purpose of farming. The yield, manufacture, sales, and allocation of harvests and animal products, however, have changed during the last 20 years. Nowadays, farming provides the majority of people with a living, boosts GDP, facilitates commerce, lowers unemployment, provides resources for other sectors, and advances the economy.

The worldwide geometric population growth necessitates a study of agricultural methods in order to provide creative ways to sustain and enhance agricultural activity. The inception of AI in farming can be made possible by additional scientific advancements, such as big data analysis, robotics, the IoT, the accessibility of inexpensive sensors and cameras, drone technology, and even widespread internet

Chapter 22. A Conceptual Framework for Addressing the Information of Farmers: A Study on Digital Agriculture

Agriculture is becoming a more knowledge-intensive industry in developing nations. Researchers continue to produce new information on a global, regional, and national scale. As agriculture systems advance, access to reliable, accurate, and pertinent information sources become more crucial to farmers' ability to compete. In addition to being prepared and provided in a way that appeals to farmers, the information must be useful and relevant to them. Context-specific information may have a bigger impact on the adoption of technology and increase farm output for marginal and small agricultural landowners.

As appropriate educational and selling methods for farmers must take into account how farmer teams differ in their knowledge search behavior, a better understanding of farmers' agricultural information preferences and knowledge search behaviors may help extension and other agricultural programs better target certain groups of farmers. This has important implications for extension programs, particularly when information gaps in public-sector extension systems (such restricted access to farmers and feedback) have reduced the relevance of the material and, as a result, the impact of extension programs.

Data is expanding at an infinite rate, and patterns are changing as quickly as concepts are wandering. Program designers can create interventions that specifically target users with certain information needs. It is possible to categorize information needs using the "agricultural cycle". The strategy needs to cover all of the decision-making stages that a farmer encounters during a growing season, including input acquisition, production planning, cultivation, harvesting, packaging and storing, transportation, and sale. Nonetheless, it is important to recognize the usefulness of an information needs assessment that involves direct interaction with information users.

Chapter 23. Appropriate Technology and Adaptation Strategies Mitigate the Adverse Impact of Climate Change on Agricultural Sector: A Case Study in Gujarat, India

Previous evidence indicates that most climatic factors work as crucial inputs in agricultural production activities. Production, yield and plant growth of a particular crop depend on climatic conditions and geographical location. Therefore, the progress of agriculture and its allied sector also depend on climatic factors.

Though, high variability and variation in climatic factors may be harmful for plant growth, production and yield of most crops. The variability in minimum and maximum temperature, rainfall, wind storms, wind speed, sun intensity and solar radiation increased due to human driven and natural activities.

Human driven activities have a huge contribution in greenhouse gases (GHGs) emissions in the atmosphere. Also, demographic changes (i.e., population growth and urbanization), overwhelming industrial and infrastructural development are also accountable to increase GHGs emissions. High concentration of GHGs emissions in the atmosphere is a sole origin for unexpected changes in climatic factors.

Accordingly, mean temperature of earth surface and frequency of natural disaster like floods and drought, hailstorm and heat waves have increased globally due to rising GHGs emissions. Moreover, the water availability, air quality, soil fertility and ecosystem services have declined due to human driven activities and climate change. Therefore, human development is also negatively affected due to extreme variability in climatic factors in most agricultural intensive countries. The prevalence of various health diseases in different weather seasons have also increased due to climate change.

Furthermore, the developing countries which are located at low latitude are more susceptible due to climate change. Yields of many crops are expected to be increased in developed countries, while, the developing countries which are located at lower latitude will get negative returns in the agricultural sector due to climate change.

Happy reading!

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