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CLIMATE CHANGE, IOT AND AI ASSISTED MANAGEMENT SYSTEMS AND SCOPE FOR LOCAL TO GLOBAL AGRICULTURE ECONOMIC GROWTH

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Abstract

Climate Change and Monsoon Pattern Change are the main challenges in front of a Local to Global Agriculture Industry and overall Human Civilization. The Agricultural Industry or sector is an important source of economy. 195 countries of the world with one-third hunger-starving out of 7.96 billion World population is dependent on agricultural land and food grain, vegetables, fruits, medicinal plants, and employment. The Agricultural land area of the world is only 38.4 percent as of 2011 and World Bank reported the agricultural land area in India at 60.43 percent in the year 2018. Hence the whole world is looking with hope toward India for food. The agriculture sector is reducing day by day due to construction. Agriculture provides benefits to farmers and contributes directly to the country's Gross Domestic Product (GDP). There is a huge need and limited work and a wide scope of research for the design and development of universally applicable, acceptable, efficient, effective, optimum cost-effective systems with the help of the Internet of Things (IoT) and Artificial Intelligence (AI) and other technologies which can contribute from home automation and local to global Agriculture Economic Growth by providing the vital solution to enhance the quality product and reducing the risks in agriculture and as well as promote the Smart Agriculture practices. Increasing crop production is quite challenging due to frequent changes in the chemical and physical conditions of the surrounding environment and this issue needs to be solved at the earliest. Strict management and continuous monitoring are needed to improve agriculture activities related to the soil such as temperature, PH value, humidity, soil environment, light intensity, plant disease, and other parameters. This study analyses and explore the new possibilities for practical implementable system design and development with Applications of IoT and AI assisted systems for Effective and Efficient automation to solve the problem of food scarcity and management of fields, small farm houses, residential Gardens, Home Automation, and scope for Global Agriculture Economic Growth in terms of Climate Change and Monsoon pattern change scenario. This research paper also emphasises the new possibility of adoption of innovative technologies like AI and IoT and problem-solving approaches for the utilization of terraces, land surrounded by bungalows, and homes can certainly contribute a local to national level food security and as well as in Global Agriculture Economic Growth.

Keywords: Climate Change, Smart Agriculture, Artificial Intelligence, Internet of Things, Home Automation, Machine Learning, Economy, Weather conditions, Management Systems

Introduction:

The Internet of Things (IoT) is a wide term and we can define it as, a grid of intelligent equipment, parameter sensors, and analysing systems that interconnect and interact with each other without human interventions and sometimes, or in some cases with human interferences. Artificial Intelligence (AI) is nothing but a duplication of human intelligence with the support of mechanisms or computers.

195 countries of the world with one-third hunger-starving out of 7.96 billion World population is dependent on agricultural land and food grain, vegetables, fruits, medicinal plants, and employment. The agricultural land area of the world is only 38.4 percent as of 2011 and the agriculture sector is reducing day by day due to construction. World Bank reported the agricultural land area in India at 60.43 percent in the year 2018. Hence the whole world is looking with hope toward India for food.

IoT and AI are allowing Agriculture Industry to have cost-effective production, become data-driven, and timelier, management of farms, and decrease environmental impact. AI and IoT technologies can make positive changes in traditional agriculture and can be used for home automation to solve the problems of optimum watering of plants in small farmhouses, and residential gardens for the production of vegetables, fruits, medicinal plants so many other activities and tasks. Smart agriculture sensors can be used to collect improved and more accurate data; manage and monitor internal activities within a smart agriculture environment; decrease waste of water and cost saving. By making the traditional processes automatic, business efficiency can be increased; and improves the quality and quantity of production (Sin war, Dhaka, Sharma and Rani, 2020).

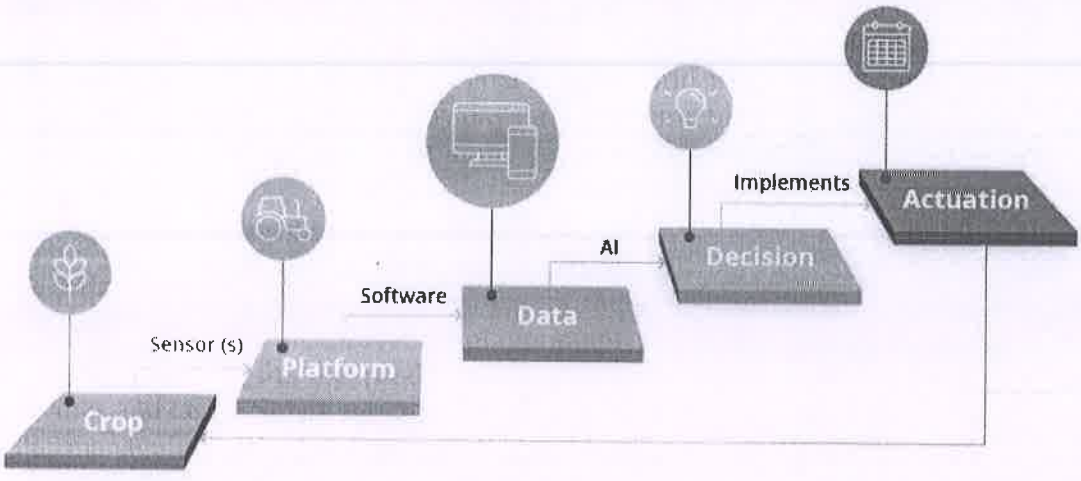

Figure 1: Use of IoT and AI for Smart Agriculture
Source- https://www.intellias.com/artificial-intelligence-in-agriculture/

For proper and effective adoption of smart IoT and AI technologies in the field of agriculture, it is important that farmers are fully aware of the technologies available and must be trained to operate these technologies (Gupta, Salpekar, and Tejan, 2018).

There is another side of the cost-related issues especially for Asian and African countries compared to developed nations such as the USA and arguing that, if these technologies are utilised appropriately, then their purpose or objective will not be effective and will cost more to farmers. In addition, it is important to validate and test IoT and AI applications as high risk is involved in using these technologies and the agriculture sector is very crucial. There is a huge influence of environmental factors on the agriculture sector and hence it is vital to monitor the weather and Climate Change for effective quality and quantitative production. IoT applications with AI monitor weather conditions and help farmers in decreasing the risk to crops, optimum use of resources and protect crops, enhance product quality and suggest the best time for harvesting, and send timely and constant notifications (Siva and Gupta, 2016).

However, Climate Change makes things complex for farmers and encourages them to use climate flexible agricultural activities. AI weather prediction, IoT weather stations, and weather collection data management systems help agriculture businesses to manage priority, store and process a huge amount of data to deal with the variations in Climate Changes and weather parameters in advance and respond by fast predefined actions on any unexpected weather change. Data gathered from IoT sensors, historical databases, satellites, and exercise machines are used to predict weather (Ragavi, Pavithra, Sandhiyadevi, Mohanapriya, Harikirubha, 2020).

With IoT and AI, farmers get constant timely information on soil and the environment and can plan their agricultural activities before the weather changes. When weather sensors provide disturbing data then it may be a notified upcoming rainfall or forest. Wireless Sensor Networks (WSNs), smartphones, integrated farm information management systems, automatic vehicles, and robots are found to be capable to lead normal farming to smart farming (David, Anand, and Sagayam, 2020).

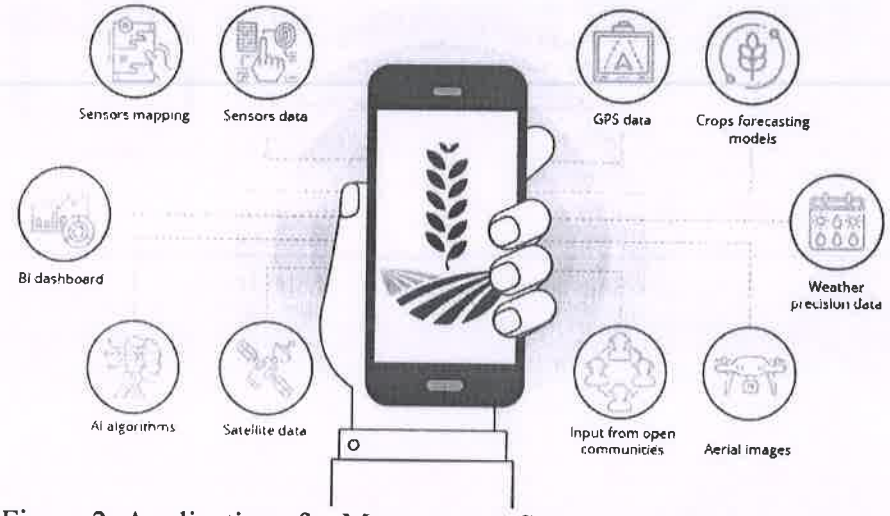

Figure 2: Applications for Management Systems for Global Agriculture Economic Growth
Source: https://www.intellias.com/weather-monitoring-technologies-to-save-crops-from-mother-nature/

The issues and challenges faced by farmers during the adoption and implementation of IoT and AI applications are mostly related to network, affordability, power or energy consumption of devices, security, and privacy. (Dharmaraj and Vijayanand, 2018). Various solutions are also observed in

many studies like middleware platforms, machine learning, or intelligent data management. Much research is done on IoT applications for smart agriculture and its contributions are analysed continuously. Hence this research field is constantly getting explored with new suggestions and improving continuously.

Literature Review:

Aggarwal and Singh (2020) revealed that IoT has attached daily things of households to the internet and makes them capable to make decisions like human beings. With the help of AI, sensors gather real atmospheric information and become easy to the prediction of rainfall, temperature, fertilizers need, humidity, the requirement of water, and other parameters. Modern agriculture techniques with AI and IoT revolutionize the traditional methodologies of agriculture and makes farming a profitable business.

Bhatta and Thangadurai (2019) found that IoT along with sensors network plays important role in agriculture. With the help of various sensors like humidity sensors, moisture sensors, pressure sensors, temperature sensors, rain sensors, and people can get present information related to farms. IoT detects the information and condition of farms and automation helps in looking where there is a need for a particular amount of content even in human absence.

Talaviya, Shah, Patel, Yagnik, and Shah (2020) examined that the population is increasing enormously and due to this demand for employment and food has also increased. Traditional methods used by farmers are not found sufficient to carry out these requirements. New automated methods are initiated and AI brought the agriculture revolution. The new technologies are helpful for crop protection and contribute to generating revenue over the solution for issues such as workforce, Climate Change, food security issues, and population growth.

Ullo and Sinha (2021) found that modern sensors are used in various applications like robotics, remote sensing, automation, underwater imaging, navigation, and so on. In present situations sensors with innovative techniques and AI it is playing important role in areas of smart agriculture and remote sensing. The study also assessed different smart sensors and IoT used in agriculture applications and remote sensings like weather conditions assessment, quality of soil, crop monitoring, and robot and drone usage for weeding and harvesting.

Jha, Doshi, Patel, and Shah (2019) explored various practices of automation such as IoT, Deep Learning (DL), Wireless Communications, AI, and ML. There are various areas such as shortage of storage management, crop diseases, weed management, pesticide control, irrigation facility, and water management, and all these issues can be resolved through the above-mentioned techniques.

Dewangan (2020) found that various agriculture IoT sensors, AI, and devices are associated with various benefits such as productivity enhancement, proper distribution of crops, and the suggestion of crop patterns, proper resource utilization like manures and fertilizers using techniques of AI and automation model. Agriculture modernization decreases dependency on land and human resource. The sensor network is formulated to gather data related to climate requirements of lands such as humidity, light, temperature, and soil moisture.

Alreshidi (2019) revealed that innovation of new innovative IoT technologies has the quality to monitor the environment of agriculture to make sure products are of high quality. In addition to present methods of traditional agriculture, IoT and AI technologies can enhance the quantity, quality, and performance of the production. The use of AI and IoT in the agriculture sector has led to growth in this sector and the country's economy.

Singh, Srivastava, and Mishra (2020) explored that IoT and AI based monitoring systems are becoming popular in the agriculture sector and in great demand as it provides specific data and evaluation. IoT monitoring systems monitor physical conditions such as soil temperature, humidity, moisture, temperature, and intensity of light on the growth of plants. Data can be gathered with various sensors with Application Programming Interfaces (APIs), single board microcontrollers, Noir cameras, Soil Moisture sensors, Light Dependent Resistor (LDR), DS18B20, and DHT11. The 21st century has more focus on automatic technologies such as Data Science (DS), ML, and IoT.

Navarro, Costa, and Pereira (2020) found that IoT may be used to overcome existing issues of food production in smart farming. This study analyses the adoption of IoT in smart agriculture and its main components and solutions of applicability. The study revealed that smart farming can use different network protocols simultaneously. Smart farming can also be used in other related activities of farming like livestock.

Ayed and Hanana (2021) explored that due to present issues like the COVID-19 pandemic, scarcity of resources, Climate Change, and socioeconomic speculation lead to more dependence or need for innovative technologies that can help overcome these challenges. ML and AI are found to be the more integrated approach toward improvement in food quality and the agriculture sector.

Patel, Khant, and Patel (2021) examined that new and updated technology must be used in all stages of agriculture. Water saving, storage, and its supply to farming when required have become the need of an hour as agriculture fully depends on water. The irrigation systems can be controlled by IoT and AI technologies with the help of smartphones. Soil moisture level can be detected and stored with the help of sensors that are spread on the whole farm and helps in the irrigation system automatic for the crop.

Choudhary, Qureshi, Ananthraman, and Deshpande (2020) found that in India, farmers owned small size of land; hence crop safety is very important for them. IoT and AI in agriculture farming use ML algorithm and this system use infrared sensors that detect cattle motions in the fields. Smart irrigation systems can also be used to predict the crop's water requirement.

Zaaien and Szabo (2020) explored that IoT helps in gathering data which helps in production in time, farms management at low cost, and decreases the environmental influence. Automation is found to be important for agriculture worldwide. Various AI applications in agriculture like sensor-assisted spaying, irritations, weeding, and other technologies like drones and robots. AI technologies help in managing excessive use of herbicides, and pesticides, watering and maintaining the fertility of the soil, and use efficiently strength of humans, increasing productivity and quality improvement.

Mekonnen, Namuduri, Burton, Sarwat, and Bhansali (2020) found that the use of IoT and sensors are moving the agriculture sector of the whole world to a more sustainable and productive path. Recently innovations in Wireless Sensor Networks (WSN), IoT, and Information and Communication Technology (ICT) leads to finding solutions to economic, environmental, and technical issues and opportunities in the agriculture sector.

Joseph (2019) revealed that smart agriculture consists of smart farming, marine farming, and Smart aquariums, Environment Monitoring, Smart aquariums. Environment monitoring involves weather monitoring and pollution monitoring based on IoT. The architecture according to IoT is made and implemented. Seismograph used an analog sensor based on Arduino which records vibrations from three perspectives and data is sent out with the help of a serial port.

Reddy, Abrar, and Kalyan (2019) found that IoT based system monitors environmental conditions and sensors detect parameters such as light intensity, temperature, relative humidity, and level of Carbon Monoxide (CO) gas. Sensors provide data or information to websites and show graphical statistics. This timely and updated information can be accessed from any location in the world on the internet. They also emphasise the strong need for an effective weather monitoring system is needed to evaluate and monitor the environment so that crops can be grown and harvested accordingly, and the soil is analysed, and measured moisture.

Math and Dharwadkar (2018) observed that weather and climate conditions become unpredictable and uncertain all over the world and have disturbing effects on the agriculture sector. There is a need for technology that can provide local real-time weather situation information so that farmers can take appropriate actions at right time and protect their crops. Arduino and ZigBee evaluate weather data including dew point temperature, biometric pressure, speed and direction of a wind, air temperature, humidity, and other parameters.

Kumari, Pandita, and Mittal (2018) found that smart agricultural technology based on IoT is the technology that creates effective value to agriculture production and continuous enhancement of quality agriculture products in the whole process of farming. IoT system is designed to provide an agricultural support system and help in forecasting crop growth by periodically examining with the help of IoT based sensor technology. Sensor Middleware, Cloud Semantic Datastore, Schedule, Service Delivery, and Utility Manager provide the open source IoT platform and provide relevant information to farmers.

Vincent, Deepa, Elavarasan, Srinivasan, Chauhdary, and Iwendi (2019) revealed that the assessment of agricultural land is an important tool for development in agriculture. Various innovations and new technologies are implemented in agriculture to collect and process information about farms. Fast wireless sensor network development leads to small and low-cost sensor devices with IoT application as a feasible tool for automation in the agriculture sector.

Research Gaps and Future Scope:

Extensive literature was reviewed on the topic under investigation. In the present study, an effort has been made to synchronize the available literature by making a critical review and highlighting the existing gaps. It was found that there is been a huge need and limited work on the topic chosen and there is a lack of studies in the context of the individual countries.

In the scenario of Climate Change, Monsoon pattern Change, and food gain scarcity is a big challenge in front of hunger-starving Human Civilization. When finding short-term and long-term solutions, there is a wide scope of research work, design, and development of universally applicable, acceptable, efficient, effective, optimum cost systems with the help of IoT and AI, Home Automations for residential Gardens, terraces, farms, and large the agricultural land along with new technologies in this area with new possibilities of contribution for national levels as well as in Global Agriculture Economic Growth.

Conclusion:

In the scenario of Climate Change, Monsoon pattern Change, variations in weather parameters affect the crop and food grain, vegetables, fruits, medicinal plants quantity as well as quality in small farmhouses, residential gardens and affects not only economy of the GDP of 195 countries of the globe but also on overall Global Agriculture Economic Growth. However, It is possible to fill the gap related to the lack of studies in the context of the individual countries.

Internet of Things (IoT) and Artificial Intelligence (AI) application helps in transforming traditional agriculture practices. IoT and AI can handle the monitoring, measure, analyse, and control issues of the agriculture industry or sector up to an extent, provide accurate and timely information with the help of various types of sensors to farmers, related to weather parameters such as rainfall, humidity, crop yields, soil nutrition, plant disease, pest infestation, water supply management, temperature, PH value, soil environment, light intensity, yield management, and so many other parameters. Real-time, precise, and accurate data collection from sensors, satellites, and Doppler radar systems at the large networks for weather and climate forecasting conditions will help for food security, and scope for Global Agriculture Economic Growth. Along with IoT and AI introduction of wireless connectivity, 5G and upgraded technologies will lead in the coming time.

IoT and AI help farmers in optimum use of resources save crops and automation on growing and harvest timing of crops along with Smart Agriculture. There still exist some inaccuracies in IoT and AI applications but the possibility of upgradation always exists and AI provides more promising results as compared to traditional agriculture practices.

Practically utilizable system design and development help of IoT and AI for even Home Automations for residential Gardens, farms, and as well as for large Agricultural land along with new technologies is possible. Emphasis is strongly needed for the new possibility of adoption of innovative technologies like AI and IoT and problem-solving approaches for the utilization of terraces, land surrounded by bungalows, and homes can certainly contribute to a local to national level food security and as well as Global Agriculture Economic Growth.

AI and ML self-learning abilities are vital when finding short-term and long-term solutions. IoT and AI have together several fold capabilities for solving the problem of food grains scarcity in front of hunger-starving Human Civilization.

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