iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 Issue: VIII Month of publication: August 2025

DOI: https://doi.org/10.22214/ijraset.2025.72618

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue VIII Aug 2025- Available at www.ijraset.com

Embracing of Artificial Intelligence of Things (AIoT) in Regulated Agricultural Components Towards Enhancing Agricultural Productivity and Sustainability in Nigeria

Kabiru Hamisu[1], Soumik Podder[2], SulaimanAuwaluYaro[3], HafsatSanusi Mohammed[4], AbdulnasirLawan Isah[5], Ahmad Usman Shuaib[6], MuhsinShafiu Umar[7]
[1, 3, 4, 5, 7]Aliko Dangote University of Science and Technology, Wudil Kano, Nigeria
[2, 6]Institute of Engineering and Management(IEM), University of Engineering and Management Kolkata

Abstract: The Northern region of Nigeria produces major revenue from agriculture, thereby contributes 23% of Global GDP despite of constrained land resources. The improvement in GDP can be made realizable with the incorporation of systematic, organized and sustainable smart irrigation system In this chapter, we are attempting the realization of IoT (Internet of Things) as well as AI (Artificial Intelligence) often termed as AIoT, to transform the traditional agricultural system in Northern Nigeria into smart and sustainable agriculture. Herein we are highlighting controlled and selective usage of Agrochemicals and automatic monitoring of chemical usage in agriculture with the help of AIoT to avoid chemical wastage. Machine learning appended IoT in irrigation system are described to protect crop health from climate change and other non-negotiable parameters such as population growth, employment and food security issues. Soil management with the help of AI is also discussed in this chapter. Herein, we have analyzed the pros and cons of present Nigerian agriculture especially for the northern side and presented possible AIoT based approaches like AI workshops and training to farmers, soil testing using AI, quality of chemicals testing, optimization of chemicals usage, environmental factors predictions, decision making with the help of Operations Research (OR).
Keywords: Artificial Intelligence of Things, Irrigation, Agrochemicals, Crop productivity, Chemical Selection, Northern Nigeria, Machine Learning and Operations Research

I. INTRODUCTION

A. Background of the Study

Agriculture is oldest profession of human beings started from the stone age and still become most essential to sustain and nurture human civilization. It serves as the primary source of food, making it one of the most important components of human survival [1]. Irrigation, mostly discussed topic in the context of science & technology, complexly linked with agriculture. Applications of regulated water to plants at the appropriate intervals to cultivate crops are known as irrigations. Strong administration in irrigation system can be helpful to enhance crop health. Crop growth is heavily reliant on the moisture content of the soil; an excessively wet soil can cause crop roots to rot, wash away a significant amount of fertilizer, which can contaminate water supplies, and obstruct the gas exchange between the soil and the atmosphere, which lowers root respiration and growth. Rainfall is unpredictable and unreliable, which has made irrigation a crucial component of agriculture. A significant obstacle to sustainable agricultural development in the western portion of Africa has been farmers' over-reliance on rainfall, leaving production systems susceptible to climatic change and fluctuation [2]. Some farmers have also been compelled by this to switch to seasonal farming, which depends only on rainfall cycles. Nigeria has seen an unparalleled push in recent years to increase agricultural output. Due to the current fall in agriculture's GDP contribution, there is a push to increase crop yield by making optimum use of the limited amount of water available. According to [3]. an effective and robust agricultural industry will raise GDP, provide employment, and raise living standards. Irrigation system efficiency can only be increased with technical expertise [4]. Sensors are typically used in IoT-based automated irrigation systems to monitor the farm in real time. This enables farmers to remotely check on the state of their crop land. When compared to the traditional method, this farming technique is far more inexpensive and efficient because it conserves water and uses less labor from humans.

Water conservation is encouraged by the ability of automated irrigation systems to be set to release more exact amounts of water in a designated region. Recent years have seen a significant improvement in technology, which has made life easier and simpler. fierce rivalry for the limited supply of water resources. Using automated irrigation systems is the answer to this long-standing issue [5].

II. IRRIGATION

The agricultural practice of irrigating land to help with crop production, as well as to produce landscaping plants and lawns—where it may be referred to as watering—is known as irrigation. [6] Dictionary.com, "Irrigation Definition & Meaning," Rain-fed agriculture is defined as that which depends exclusively on direct rainfall and does not require irrigation. For more than 5,000 years, irrigation has been a crucial component of agriculture, having been independently developed by numerous cultures worldwide [7]. Agricultural crops, landscape maintenance, and the revegetation of disturbed soils in arid regions and during periods of below-average rainfall are all aided by irrigation.In addition, irrigation systems are utilized in mining, sewage disposal, dust suppression, and livestock cooling. The removal of surface and subsurface water from a specific area is known as drainage, and it is frequently studied in conjunction with irrigation. 85% of the freshwater resources that are available worldwide are used by the agriculture industry. And as the population grows and the demand for food rises, this percentage is rising quickly. As a result, we must develop more effective systems to guarantee that water resources are used appropriately for irrigation. Automatic irrigation scheduling techniques took the place of manual irrigation, which was based on soil water measurement. Irrigation can be used to protect crops from frost and inhibit the growth of weeds in grain fields and preventing soil consolidation [8]. When using autonomous irrigation machines, consideration was given to plant evapotranspiration, which was dependent on a number of atmospheric parameters including humidity, wind speed, and solar radiation, as well as crop factors like growth stage, plant density, soil characteristics, and pests. By sensing the water level, soil temperature, nutrient content, and weather forecasts, smart irrigation technology is designed to boost productivity without requiring a lot of labor. The irrigator pump is turned ON or off in accordance with the microcontroller's instructions. Machine to machine, or M2M, technology was created to facilitate data sharing and communication between devices as well as between them and a server or cloud via the primary network between all the nodes of the agricultural field [9].

The first method was subsurface drip irrigation, which immediately buried the water beneath the crop, minimizing water loss from evaporation and runoff. Subsequently, researchers developed various sensors, such as soil moisture sensors and rain drop sensors, that were controlled by wireless broadband networks and powered by solar panels to determine when the fields needed to be irrigated. Using a GSM module, the rain drop sensor and soil moisture sensor send an SMS to the farmer's cell phone informing them of the soil's moisture content. As a result, the farmer can turn on and off the water supply by sending directions via SMS. Therefore, we may assume that this method will identify a portion of the field that needs more water and may discourage the farmer from watering during a downpour. Soil moisture sensors employ one of the various methods available for determining the moisture content of the soil. It is interred close to the crop root zones [10]. The sensors assist in precisely measuring the moisture content and provide the reading to the irrigation controller. Additionally, soil moisture sensors greatly contribute to water conservation [11]. Utilizing moisture sensors allows your controller to water only when necessary. We set the threshold based on the soil's field capacity. This is one method of using moisture sensors. When the appointed time comes, the sensor determines the amount of moisture content for that specific zone, and watering will only be permitted if the moisture content is less than the threshold. The other was irrigation using a suspended cycle, which, in contrast to irrigation using water on demand, needed irrigation time. According to [12]. it needs the duration and start time for each zone.

A. *Internet of Things (AIoT) In Agriculture*

Artificial Intelligence in Agriculture Artificial intelligence (AI) and the Internet of Things (IoT) are two technical developments that have the potential to significantly change the agriculture industry. The Internet is the global system of interconnected computer networks that use the Internet protocol suite (TCP/IP) to link billions of devices worldwide. Future food and agriculture systems under the new Agriculture 4.0 include ideas like aquaponics, digital agriculture, bioeconomy, vertical farming, and aquaponics [13-17]. It has had a revolutionary impact on culture and commerce, including the rise of near-instant communication by electronic mail, instant messaging, and voice-over Internet Protocol (VoIP) telephone calls, two-way interactive video calls, social networking, and online shopping sites. Moreover, Internet connectivity became the norm for many business applications and is today an integral part of many enterprises, industrial and consumer products to provide access to information. However, Internet usage still primarily focuses on human interaction and monitoring through applications (apps) and interfaces. IoT is one of the biggest revolutions of the Internet in which also physical things communicate [18].

IoT combines the concepts "Internet" and "Thing" and can therefore semantically be defined as "a world-wide network of interconnected objects uniquely addressable, based on standard communication protocols

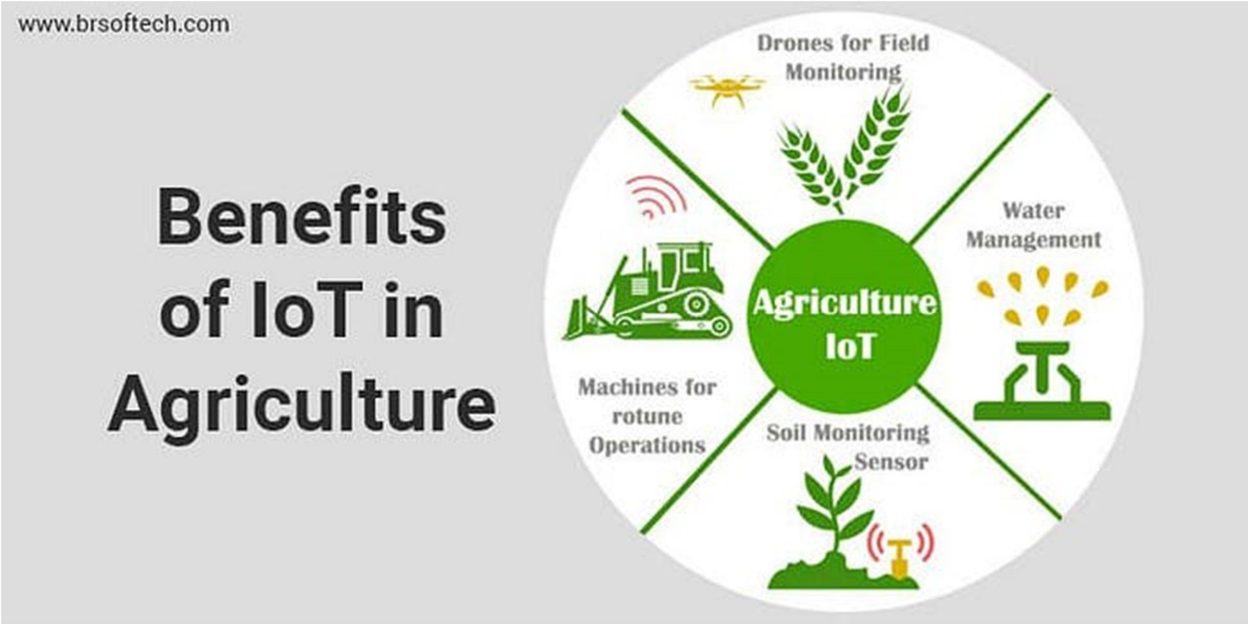


Fig 1: Boons of IoT in Agriculture sector.

B. Crop Spraying

The UAVS, otherwise called drones, are chiefly established on the innovations of sensors and microcontrollers which are grown especially with an expectation to make up for the nonattendance of the pilot and accordingly empower the trip of unmanned vehicles and their independent conduct [19]. These drones have been utilized as substance sprayers by farmers since numerous years now and they are considered as effective and of great importance in the situations of cloudy climate and has also solved the problem of inaccessibility to a field of tall crops, for example, maize [20,21]

Fig 2: UAV (Unmanned Aerial Vehicle) mediated pesticides spraying in farming land.

C. Artificial Intelligence Machine in Irrigation

Learning is a subfield of computer science that evolved from the study of pattern recognition and computational learning theory in artificial intelligence.

Machine learning explores the construction and study of algorithms that can learn from and make predictions on data. Such algorithms operate by building a model from example inputs in order to make data-driven predictions or decisions, rather than following strictly static program instruction [22]. Machine learning is closely related to and often overlaps with computational statistics; a discipline that

Also has a prediction-making specialty. It is closely related to mathematical optimization, which provides the discipline with techniques, theory, and application domains. For a variety of computing jobs where explicit method design and programming are impractical, machine learning is utilized. [23]

Fig 3: AI in irrigation system.

D. Productivity

Through cost cutting and securing higher pricing for their food, farmers are constantly seeking to increase productivity and profitability. The foundation for improved farm management is provided by AI. In the past, farmers used their expertise and experience to inform their decisions, but AI today makes it possible to combine computer and human judgment. Real-time forecasting and the innovation of business processes are the two main areas where applications of AI are transforming farm operations and management. Increased productivity is what generates operational value in the agriculture industry; phrases like yield, harvest, grower, and products make this clear. The reliance on manual labor is reduced by algorithms. AI based predictions provide lower risks, cut down on mistake, and enable more precise output projections, resulting in major efficiency gains and cost savings for the farmers.

After Motorleaf's algorithms doubled the accuracy of its weekly yield projection, SunSelect, a greenhouse in California, saw a significant reduction in costs [24]. Irrigation Sustainability producing social and environmental benefits while raising production in a way that doesn't negatively impact the environment.Artificial Intelligence (AI) facilitates the mitigation of environmental consequences by precisely applying pesticides, fertilizers, and systemized irrigation. As the excerpt below explains, precision agriculture is "reducing the environmental footprint while increasing production and advances such as... helping to make greenhouse production more efficient." It can also do this by using less chemicals and providing adequate irrigation in farm areas that require more water or specifically for crops. [25].

Regarding the agricultural sector's social sustainability, however, there are concerns about how technology may disrupt it and whether farmers' wisdom would be replaced by algorithms. Robotics and driverless tractors raise the likelihood of unemployment and socioeconomic inequity.

III. ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING APPROACH:

Artificial intelligence (AI) is a creative technique used by computers, primarily computer systems, robotics, and digital equipment, to mimic human intelligence and aptitude processes [26]. Among the many uses of artificial intelligence (AI) are speech recognition, expert systems to mimic judgment, computer vision to view analog-to-digital conversions like video, and natural language processing (NLP) to understand spoken human language. Three cognitive skills—learning (gather data and then develop algorithms to transform it into actionable information), reasoning (select the best algorithm to achieve a desired outcome), and self-correction (constantly modify created algorithms to guarantee they yield the most accurate results)—are the foundation of AI encoding [27]. To produce data-driven predictions and judgments, machine learning (ML) uses statistical and mathematical techniques to learn from datasets. There are several approaches to this. Two systems can be used to make general distinctions: the first is the symbolic approaches, which use examples and induced rules that are openly expressed, and the second is the sub symbolic approaches, which use artificial neural networks, or ANNs. Three main tasks in machine learning (ML) are supervised, unsupervised, and reinforcement learning. AI's main objective in agriculture is to provide forecasting and precision so that decisions may be made to maximize yield while preserving resources [28]. Through this, artificial intelligence (AI) tools offer algorithms to assess performance, categorize patterns, and forecast unforeseen issues or phenomena in order to address comprehension issues in the agricultural sector, identify pests and the best way to treat them, and manage irrigation processes and water consumption by putting up smart irrigation systems.

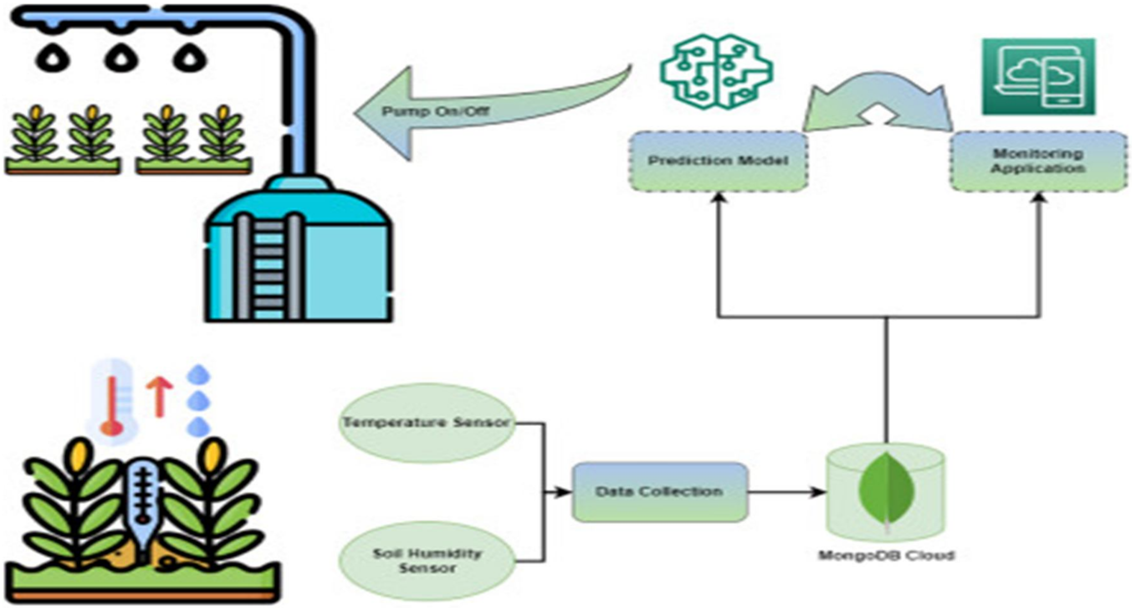


Fig 4: Implementation of Machine learning in irrigation system to turn into Smart Agriculture.

The Use Of Artificial Intelligence Of Things (Aiot) To Improve Agricultural Irrigation

Presently, there is a growing emphasis on the application of machine learning algorithms in the four primary agricultural production clusters (pre-planting, planting, post-planting, and processing) [29]. Actually, machine learning technologies are employed during the pre-planting stage, particularly for the purpose of forecasting crop production, soil characteristics, and irrigation needs. The ML might be utilized for weather forecasting and disease detection in the following planting phase. ML techniques are used with regard to the third and fourth cluster of the post-planting and processing phase, particularly for estimating production planning in order to achieve a high and safe quality of the output.In particular, ML algorithms could be applied to customer analysis, transit, and storage within the distribution cluster. Pre-planning is the first stage of agricultural production. It mostly relates to crop output forecast, soil parameters, and irrigation needs. Numerous studies note how crucial crop yield production is for improving plant management. To be more precise, these tools use data (fertilizers, nutrients, and equipment requirements) to predict efficient models based on machine learning algorithms. This helps farmers and stakeholders make the best decisions possible when it comes to crop yield forecasting and enhances intelligence in farming practices. Various machine learning methods, including the Bayesian network, regression, decision tree, clustering, deep learning, and artificial neural network, have been applied in recent times to forecast crop productivity [30–32].

According to the prediction of soil management properties, several ML algorithms are used in learning soil properties. Irrigation management is a critical aspect in the pre-planting cluster that influences both the quantity and quality of the crops. In actuality, researchers used soil moisture data, precipitation data, evaporation data, and weather forecasts as input data for simulation and optimization of predicted models based on ML suitable algorithms in order to achieve an effective irrigation system (better decision in when, where, and how much to irrigate).[33].

The second stage of the agricultural supply chain is the planting cluster. The crop production process is heavily influenced by a wide range of factors. The management of crop quality, harvesting, crop protection against biotic stress factors (weeds and infections) and abiotic stress factors (nutrient and water deficit), and weather forecasts (sunlight, rainfall, humidity, etc.) are a few of them. Effective models for weather prediction are simulated using a variety of machine learning (ML) techniques, including ANN, deep learning, decision trees, ensemble learning, and instance-based learning [34]. for weed detection (ANN, decision tree, deep learning, and instance-based learning) and crop protection (clustering and regression)[35].[36] data mining techniques including k mean clustering, k nearest neighbor, ANN, and SVM; deep neural networks; and crop quality management (clustering and regression).

Predicting the fruit's color change or the crop's final horticulture stage following crop ripening is another application of machine learning algorithms in the post-planting third stage. In reality, a lot of research teams have employed machine learning (ML) algorithms to forecast the ripening stages and maturity of fruits. For example, [37] was able to classify strawberry fruits into early-ripe and ripe stages with 98.6% classification accuracy using hyperspectral datasets and the AlexNet CNN deep learning model.

The fourth step in the supply chain for agricultural is the processing cluster. There are many different ways to process agricultural products, including heating, cooling, milling, smoking, cooking, and drying. Selecting the right combination of parameters at the processing stage ensures both a high-quality and abundant food product while also preventing resource overuse. Many food companies use software algorithms based on machine learning (ML) to accomplish this goal by utilizing contemporary food processing technologies. The Bayesian network, ANN, genetic algorithm, and clustering are some of the machine learning techniques that are employed [38].

E. Robots in Agriculture

Large, low-productivity economic sectors like agri-food are introducing robotics and autonomous systems (RAS). Agriculture production and management have benefited greatly from robotics. Due of the inefficiencies of conventional farming machinery, researchers have recently placed a greater emphasis on technology for designing autonomous agricultural implements [39]. This technology was developed primarily with the intention of replacing human labor and generating benefits on both small and big industrial scales [40]. Robotic technology have greatly increased production in this industry [41]. The autonomous robots are carrying out a range of agricultural tasks, including irrigation, weeding, protecting farms to ensure efficient reporting, preventing production loss due to unfavorable environmental conditions, improving accuracy, and managing individual plants in novel ways. To ascertain the precise location of seeds, a simple automated approach was presented [42]. Additionally, extremely accurate seed positioning was created. Devices that guarantee the sown seeds have no ground velocity This is crucial because it guarantees that, upon the impact of the soil, the seed will not bounce from its original place. Automated devices documented the plant's progress or status. Numerous biosensors were set up to track plant growth and identify plant illnesses [43].The manual weeding method was superseded by laser weeding technology, which uses a mobile, focussed infrared light beam controlled by computers to damage weed cells [44]. Additionally, automatic irrigation systems were developed to make efficient use of water[42].

Fig 6: robot in irrigation

IV. CONCLUSION

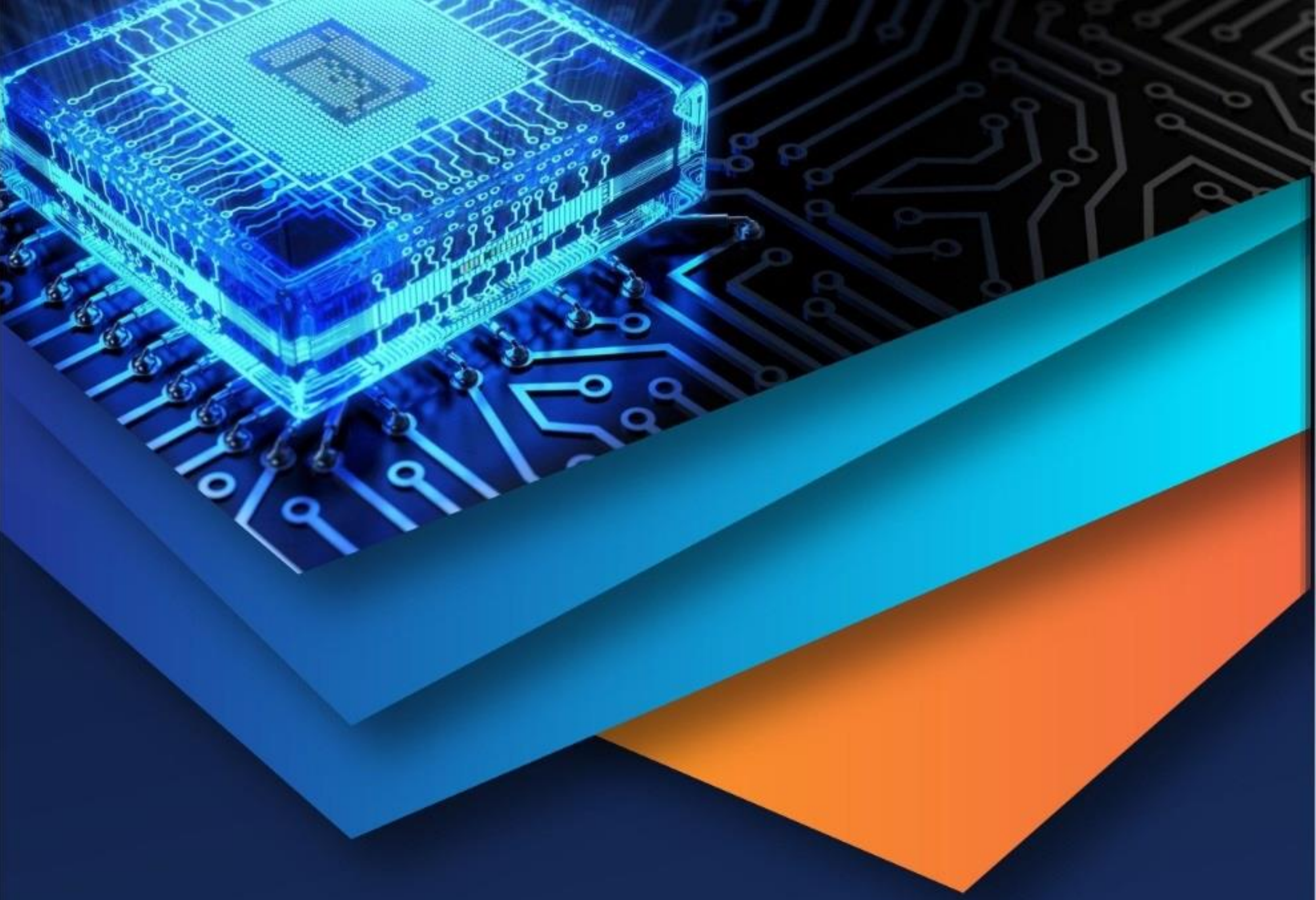
Consequently, this research progresses agriculture. Initially, the study contributes to the irrigation literature by highlighting the significance of AI in tackling sustainability concerns in irrigation. Secondly, the paper highlights a topic that has historically gotten little attention in agricultural science. Given the significance of agriculture for food security, the world's current food crises and environmental problems can be solved in unique ways using artificial intelligence (AI) and the Internet of things (AIoT). Additionally, understanding how AI and AIoT are used and accepted in the agriculture sector might help with the development of AI solutions for other, related industries. In conclusion, agricultural artificial intelligence (AI) is still in its infancy, but there is great potential for this technology to advance and be able to address major environmental challenges alongside critical crop yield difficulties.

Conflict of Interests
Authors declare no conflict of interests

REFERENCES

[1] E. Ogunti, “IoT Based Crop Field Monitoring and Irrigation Automation System,” Int. J. Recent Technol. Eng., vol. 6, no. 3, pp. 124–129, 2019
[2] D. Boansi, J. A. Tambo, and M. Müller, “Intra-seasonal risk of agriculturally-relevant weather extremes in West African Sudan Savanna,” Theor. Appl. Climatol., vol. 135, no. 1–2, pp. 355–373, 2019, DOI: 10.1007/s00704-018-2384
[3] A. Oluwaseyi, “The Prospects of Agriculture in Nigeria: How Our Fathers Lost Their Way - A Review,” Asian J. Econ. Bus. Account., vol. 4, no. 2, pp. 1–30, 2017, DOI: 10.9734/ajeba/2017/35973.
[4] P. Rajalakshmi and D. Mahalakshmi, “IOT Based Crop-Field Monitoring And Irrigation Automation,” 2018 2nd Int. Conf. Inven. Syst. Control, no. Icisc, pp. 478–483, 2018
[5] R. Remalatha, G. Deepika, K. Dharanipriya, and M. Divya, “Internet of Things(IoT) Based Smart Irrigation,” vol. 2, no. 2, pp. 128–132, 2016.
[6] Dictionary.com, "Irrigation Definition & Meaning

[7] Shirsath, P. D. O., Kamble, P., Mane, R., Kolap, A., & More, P. R. S. (2017). IOT Based Smart Greenhouse Automation Using Arduino. International Journal of Innovative Research in Computer Science & Technology, 5(2), 234–238. https://doi.org/10.21276/ijircst.2017.5.2.4
[8] Williams, J. F., Roberts, S. R., Hill, J. E., Scardaci, S. C., &Tibbits, G. (1990). IPM: Managing water for weed control in rice. Managing Water for Weed Control in Rice, 44(5), 7–10. https://doi.org/10.3733/ca.v044n05p7
[9] (Shekhar et al., 2017). A Banerjee, A Ganguly, S **Shekhar**… - … on knowledge and …, **2017** - ieeexplore.ieee.org Data science models, although successful in a number of commercial domains, have had limited applicability in scientific problems involving complex physical phenomena
[10] Dukes, J. S., Pontius, J., Orwig, D., Garnas, J. R., Rodgers, V. L., Brazee, N., ... &Ehrenfeld, J. (2009). Responses of insect pests, pathogens, and invasive plant species to climate change in the forests of northeastern North America
[11] Quails et al., 2001 Soil moisture sensors for urban landscape irrigation: Effectiveness and reliability
[12] Yong, Yam SAY Yew, C.-K. Wee's (2018)Financial knowledge, attitude and behaviour of young working adults in Malaysia.
[13] Hermans, (2018) Agriculture 4.0 include ideas like aquaponics, digital agriculture, bioeconomy, vertical farming, and aquaponics;
[14] Junge et al., 2017; Agriculture 4.0 include ideas like aquaponics, digital agriculture, bioeconomy, vertical farming, and aquaponic
[15] Pigford et al., 2018; Agriculture 4.0 includes ideas like aquaponics, digital agriculture, bioeconomy, vertical farming, and aquaponic
[16] Pinstrup-Andersen, 2018; Agriculture 4.0 include ideas like aquaponics, digital agriculture, bioeconomy, vertical farming, and aquaponic
[17] Herrero Acosta et al., 2019). Agriculture 4.0 include ideas like aquaponics, digital agriculture, bioeconomy, vertical farming, and aquaponic
[18] Patel, K. K., Patel, S. M., & Scholar, P. G. (2016). Internet of Things-IOT: Definition, Characteristics, Architecture, Enabling Technologies, Application & Future Challenges. International Journal of Engineering Science and Computing, 6(5), 1– 10. https://doi.org/10.4010/2016.1482
[19] Spoorthi S., B. Shadaksharappa, Sai Suraj and V.K. Manasa (2017) Freyr drone: Pesticide/fertilizers spraying drone - an agricultural approach
[20] D Silva, B Sinclair, S Sperling, E Stupka, K Sugiura, (2005) comprehensive polling of transcription start and termination sites and analysis of previously unidentified full-length complementary DNAs - science.org
[21] Simelli and Tsagaris,(2015) The Use of Unmanned Aerial Systems (UAS) in Agriculture., HAICTA (**2015**), pp. 730-736. View in Scopus Google Scholar. 35. Yao,
[22] Kohavi, R., & Provost, F. (1998). Glossary of Terms. Machine Learning, 103(3), 239– 248. https://doi.org/10.1023/A
[23] P. (2013). Introduction to Machine Learning (Vol. 19, Issue 2) https://doi.org/10.1017/s1351324912000290
[24] [R. Marowits, https://tinyurl.com/y4fdr9pc [accessed 2019-5-1]]
[25] A. Liris, and G, Sawyer, https://tinyurl.com/y9o2pbyb [accessed 2019-5-13]
[26] GS Patel, A Rai, NN Das, RP Singh (2021) Smart agriculture: emerging pedagogies of deep learning, machine learning and internet of thingsbooks.google.com
[27] A. Gharaei, M. Karimi, and S. A. HoseiniShekarabi, "An integrated multi-product, multi-buyer supply chain under penalty, green, and quality control polices and a vendor managed inventory with consignment stock agreement: the outer approximation with equality relaxation and augmented penalty algorithm," Applied Mathematical Modelling, vol. 69, pp. 223–254, 2019.
[28] G. S. Patel, A. Rai, N. N. Das, and R. P. Singh, Eds., Smart Agriculture: Emerging Pedagogies of Deep Learning, Machine Learning and Internet of 5ings, CRC Press, Boca Raton, FL, USA, 1st edition, 2021
[29] O. Ahumada and J. R. Villalobos, "Application of planning models in the agri-food supply chain: a review," European Journal of Operational Research, vol. 196, no. 1, pp. 1–20, 2009.
[30] R. Ben Ayed, K. Ennouri, F. Ben Amar, F. Moreau, M. A. Triki, and A. Rebai, "Bayesian and phylogenic approaches for studying relationships among table olive cultivars," Biochemical Genetics, vol. 55, no. 4, pp. 300–313, 2017. [17]
[31] D. Elavarasan, D. R. Vincent, V. Sharma, A. Y. Zomaya, and K. Srinivasan, "Forecasting yield by integrating agrarian factors and machine learning models: a survey," Computers and Electronics in Agriculture, vol. 155, pp. 257–282, 2018. [18]
[32] C. Zhang, J. Liu, J. Shang, and H. Cai, "Capability of crop water content for revealing variability of winter wheat grain yield and soil moisture under limited irrigation," Science of
[33] A. Goap, D. Sharma, A. K. Shukla, and C. Rama Krishna, "An IoT based smart irrigation management system using Machine learning and open source technologies," Computers and Electronics in Agriculture, vol. 155, pp. 41–49, 2018.
[34] M. K. Saggi and S. Jain, "Reference evapotranspiration estimation and modeling of the Punjab Northern India using deep learning," Computers and Electronics in Agriculture, vol. 156, pp. 387–398, 2019.
[35] A. Singh, N. Shukla, and N. Mishra, "Social media data analytics to improve supply chain management in food industries," Transportation Research Part E: Logistics and Transportation Review, vol. 114, pp. 398–415, 2018.
[36] K. Liakos, P. Busato, D. Moshou, S. Pearson, and D. Bochtis, "Machine learning in agriculture: a review," Sensors, vol. 18, no. 8, p. 2674, 2018.
[37] Z. Gao, Y. Shao, G. Xuan, Y. Wang, Y. Liu, and X. Han, "Realtime hyperspectral imaging for the in-field estimation of strawberry ripeness with deep learning," Artificial Intelligence in Agriculture, vol. 4, pp. 31–38, 2020.
[38] X. Ma, S. Wang, and Q. Bai, "Coordination of production scheduling and vehicle routing problems for perishable food products," International Journal of Internet Manufacturing and Services, vol. 6, no. 1, p. 79, 2019.
[39] MahirDursun and SemihOzden (2011). A wireless application of drip irrigation automation supported by soil moisture sensors
[40] **Manivannan and Priyadharshini**, **2016**. Agricultural robot. International Journal of Advanced Research.https://www.sciencedirect.com › science › article › pii
[41] Morellos, X.-E. Pantazi, D. Moshou et al., "Machine learning based prediction of soil total nitrogen, organic carbon and moisture content by using VIS-NIR spectroscopy," Biosystems Engineering, vol. 152, pp. 104–116, 2016
[42] H. W. Griepentrog, M. Nørremark, H. Nielsen and B. S. Blackmore (2005) Seed Mapping of Sugar Beet
[43] panelTanha Talaviya, Dhara Shah , Nivedita Patel, Hiteshri Yagni, Manan Shah (2001) Implementation of artificial intelligence in agriculture for optimisation of irrigation and application of pesticides and herbicides; https://www.sciencedirect.com/science/article/pii/S258972172030012X
[44] Simon Blackmore, Hans W. Griepentrog, Spyros Fountas and T. A. Gemtos (2006). A specification for an autonomous crop production mechanization system. 10.17660/ActaHortic.2009.824.23



10.22214/IJRASET

INDEX COPERNICUS
45.98

IMPACT FACTOR:
7.129

TOGETHER WE REACH THE GOAL
IMPACT FACTOR:
7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY