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Controlling Sub-Sahara African Agricultural Resources for Sustainable Development with the use of Artificial Intelligence Based Monitoring Assistive Technology (Aibmat)

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Abstract

Sub-Sahara Africa's Agricultural activities are of great value and diversity, it surpassing that of many other places in the world (Ojuope et al, 2023). The varieties of Agricultural activities attracts the attention of tourists to this region of the continent. Africa's Agricultural resources has been seen as a valuable asset to promote food productivity and encourage sustainable development. The value of Agriculture and wildlife cut across climate change control, economic, ecological, medicinal, educational, scientific, recreational and intrinsic reasons. It provides employment and contributes to the national incomes of many countries through earnings from agricultural tourism and the sale of agricultural products. The effect of illegal farming activities on African forest calls for the training of the resources explorers most especially on the use of Information Technology based forest monitoring Artificial Intelligence for managing, protecting and preserving these resources. As a result of this, this, work focused on ccontrolling sub-Sahara African Agricultural resources for sustainable development with the use of artificial intelligence based monitoring assistive technology (AIBMAT*)*. The paper also review related articles and come up with different monitoring strategies. In efforts to preserve the diversity of Agricultural resources in sub-Sahara Africa, various actors have suggested a various strategies for protecting, preserving, monitoring and managing the resources.

Key words: Agricultural Resources, Artificial Intelligence, Sustainable Development, Sub-Sahara Africa, Monitoring.

Introduction

Sub-Sahara African is very rich in Agricultural resources, managing and preserving these resources is the major challenge facing this region. The use of Artificial Intelligence to monitor, manage and protect these resources from illegal activities is a welcome option. Artificial intelligence has been applied widely in our daily lives in a variety of ways and on various fields with lots of successful stories. AI equally contributes to dealing with the COVID-19 corona virus global pandemic disease which has been happened around the world (Simon, 2020). Agricultural activities are essential part of resources that drive the world economy. This sector is affected on daily basis by human activities across the continent of Africa. Most especially during unfavorable condition such as climate change and pandemic outbreak such as COVID 19 lock-down imposed to control the wild spread of the deadly disease. Some people hide under these situations to carry out illegal farming activities such as bush burning, cutting of trees, fishing and several other ones. As a result of this, the use of artificial intelligence based monitoring assistive technology (AIBMAT*)* for monitoring, managing, protecting and preserving these resources becomes highly imperative. The challenges in Agricultural sector, has dramatically accelerated the adoption of Artificial Intelligence (AI) in Agricultural activities. Monitoring agricultural activities in African during this period has been challenging, therefore the need for artificial Intelligence to enhance the monitoring of human activities on our agricultural sector cannot be overemphasized.

Sub-Sahara African Agricultural Resources Preservation

The sudden emerging of global COVID-19 pandemic crisis has changed all aspects of human life, including resources production together with the industries. This has brought about a slowdown in the global economy as a result of efforts to control the spread of COVID-19 by imposing lock - down. However, the effect of the crisis agricultural activities remains a subject of discussion. Most countries consider agricultural activities as essential resources; the sector hit setback with diverse illegal human activities during the COVID-19 outbreaks. This challenge calls for the use of ICT based monitoring artificial intelligence to check mate future occurrence. The specific nature of forest and wildlife conservation that has direct impact on the global agricultural sector may not be as significant as the impact on the economic value of these resources. The fact that illegal agricultural activities was at alarming rate during the COVID-19 crisis cannot be overemphasized. The economic effect of COVID-19 pandemic crisis may be sharp and deep but a return to economic normality may not be equally as rapid (Simon, 2020). Some governments allowed mining to continue during the COVID-19 pandemic with somewhat limited restrictions relating to COVID-19 mitigation (Table 1). This challenging situation call for training of resources workers most especially on the use of

Artificial Intelligence based monitoring assistive technology for protecting and preserving Sub-Sahara African Agricultural activities during unfavorable situation.

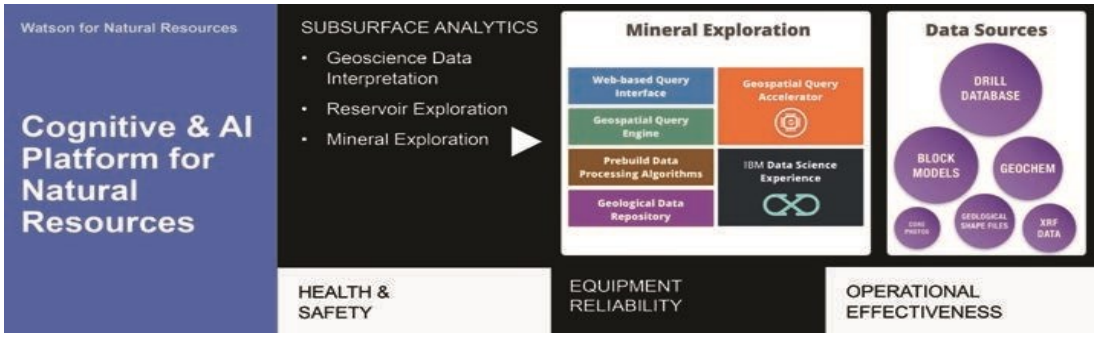


Fig. 1 Roundtable: How big data solutions of AI will lead to new mineral discoveries and Exploiration
Source: Anthony (2021), Using Big Data and AI for Smarter Mineral Exploration 2020.

Artificial Intelligence and Mineral Resources Exploration, Protection and Preservation

The purpose of the round table is to leverage the potential of cloud computing, cognitive analytic and machine learning on mineral resources discovery, exploration and preservation. The objective is to make geologists more productive with the use of artificial intelligence which is a tool for them. We are not going to replace geologists ever but we can get them thinking more with the use of Technology, asking questions and getting quick answers. These are problems the round table discussion were trying to solve underground, with sparse information. It's not easy to achieve, so they are trying to use all of this technology with the support of and IBM's (International Business Machines) experience to build something new in mining industry to do this. From Figure 2 (Thanveer et al. 2022), If Artificial Intelligence could be used to monitor patient activities in the hospital it can as well be deployed to monitor illegal human activities in the forest reserve and wildlife conservation.

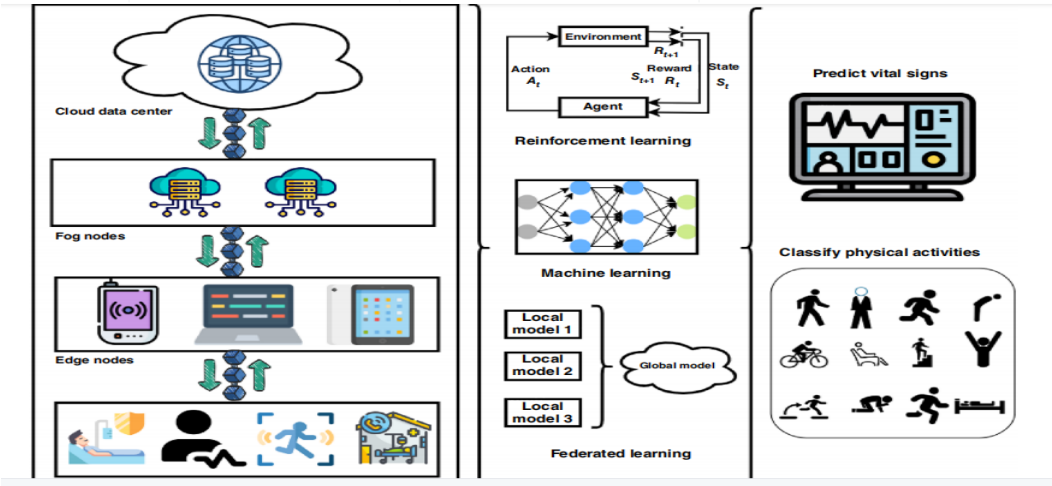


Figure 2, Artificial intelligence-enabled remote patient monitoring architectures.
Source: Thanveer et al. 2022.

Agricultural activities monitoring system

The forest and wildlife guards monitored human activities in forest and wildlife conserved areas regularly and manually and maintained the records. Collecting wildlife activities are very vital in the forest reserve. The efficient of it depends on factors like personnel workload, staff working hours, wildlife activities, guard leadership, and national guidance (Smith et al., 2017) and was limited due to the lack of resources. The forest and wildlife monitoring was with invasive devices requiring wildlifes' skin contact to estimate their vital signs. Technological advancements in data transmission have disrupted the wildlife activities with non-invasive devices without touching wildlife's bodies and provided opportunities to monitor forest and wildlife continuously. The innovations will transform the traditional forest and wildlife monitoring and enabled monitor of forest and wildlife remotely in forest reserved wildlife conservation areas, this is where the use of artificial intelligence based monitoring assistive technology (AIBMAT*)* becomes necessary.

LITERATURE REVIEW

Ojuope et al., (2023) stated that Sub-Sahara Africa's forest and wildlife reserves are of great diversity, several of it surpassing that of many other places in the world. The variety of forest reserve and wildlife conservation and their unique habitats took the attention of tourists to the continent. Africa's forest reserve and wildlife conservation has been seen as a valuable asset to control climate change, and has been protected by different means. The value of forest and wildlife cut across climate change control, economic, ecological, medicinal, educational, scientific, recreational and intrinsic reasons. It provides employment and contributes to the national incomes of many countries through earnings from wildlife tourism and the sale of wildlife products. The effect of human activities on African forest and wildlife growth and development calls for the training of the resources explorers most especially on the use of Information Technology based forest monitoring Artificial Intelligence for managing, protecting and preserving these resources. As a result of this, this, work focused on Managing Sub-Sahara African Forest Reserved Resources for Controlling Climate Change with the use of Information Technology Based Forest Monitoring Artificial Intelligence (FMAI). The paper also review related articles and come up with different monitoring strategies. In efforts to preserve the diversity of free-ranging forest and animals in Africa, various actors have suggested a various strategies for managing the resources.

Krishna, (2023) affirms that there are significant challenges emanated from the Agricultural sector of the fast world growing global population due to factors such as industrialization, reduced farmland, and biotic and abiotic stresses. Providing solution to these these challenges and ensure future sustainability, the agricultural system needs to be more productive. The use of Artificial intelligence (AI) has emerged as powerful tools to transform the Agricultural sector into a sustainable development. Agricultural productivity has been tremendously influenced by biotic and abiotic stresses, and developing climate-smart crops through conventional breeding techniques is time-consuming and challenging. Plant phenotyping, involves measuring specific plant features related to function, this is important in breeding for target traits. Meanwhile, traditional phenotyping methods are laborious, error-prone, and less

accurate, particularly under stress conditions. Therefore to overcome these limitations, researchers have focused their attentions on developing high-throughput phenotyping technologies. State-of-the-art imaging technique.

Ersin et al., (2023) established the fact that the increase in global population with the alarming increasing demand for all over the world with the climate change, it is also very clear that artificial intelligence (AI) has changed both the quality and the quantity of Agricultural sector. Agricultural Researchers and scientists have therefore focusing on the utilization of the new technology which encourage farmers to use AI in the of improvement of Agricultural services such as seeds and crop protection, application of fertilizers, irrigation etc which improves farmers' profitability and the economic development. The paper stated that in agriculture, AI emerge in three major categories namely soil and crop monitoring, predictive analytics, and Agricultural robotics. As a result of this, farmers are increasingly adopting the use of sensors and soil sampling to gather data that can be used for farm management systems which can be used further for investigations and analyses. This paper contributes to the field by surveying AI applications in the Agricultural sector. It starts with background information on AI, including a discussion of all AI methods utilized in the Agricultural industry., such as machine learning, the IoT, expert systems, image processing, and computer vision. The work then finally explore the benefits and challenges of AI applications together with a comparison and discussion of several AI methodologies applied in smart farming, such as machine learning, expert systems, and image processing.

Michael et al., (2022) stated that most developing nations rely depends mostly on rain and then employment of traditional mechanisms to mitigate and control of emergency spread of crop pests and disease and their effects. The paper observed that global warming has severely affected Agricultural productivity globally making food insecurity vulnerable. Lands has been unproductive as a result of Inadequate extension services and hardly accessible information from Agricultural agencies both at the local and national governments. While taking strong steps to address this problem, this work argues that leveraging digital tools could support the farmers to improve the productivity of their farms amidst the aforementioned challenges. Emerging artificial intelligence (AI) as a veritable technology tools enable development of applications that provides the farmers with the relevant, timely and accurate Agriculture information required to support decision making process.

Tanha et al., (2020) stated that Agriculture plays a vital role in the global economic development. Bringing technology which provides automation in agriculture is the main focus and the primary issues across the world. The world population is increasing rapidly and with this increase the demand for Agricultural products also increasing at alarming rate. Traditional methods of farming employed by most farmers across the globe were no longer adequate to take care of these demands. Therefore modern automated methods were employed which satisfied the food requirements and also provided employment opportunities to billions of people across the globe. Artificial Intelligence (AI)has become a veritable agricultural tools to introduce agricultural revolution. AI is a technology which protects and preserves crop yields from various factors like the climate changes, population growth, employment issues and the food security problems with the use of various applications of Artificial intelligence

in agriculture such as irrigation, weeding, spraying, pests and disease control monitoring with the help of sensors and other means of the technology.

Olivier et al. (2020), worked on Edge Computing and Artifificial Intelligence for Real-time Poultry Monitoring, International Workshop on Artificial Intelligence & Internet of Things (A2IoT). the work observed that smart poultry acquires data from aviaries with the use of sensor network at reduced intervals of time that generate millions of data. The combination of Internet of Things (IoT) and Artificial Intelligence open the field of the real-time monitoring of poultry and ,advance analytic and automation if data is from high quality. This work proposed a scalable monitoring of a poultry achieved with open hardware wireless sensors network and software.

Thanveer et al. (2022), worked on the Remote patient monitoring using artificial intelligence: Current state, applications, and challenges. The work explained that the adoption of artificial intelligence (AI) in healthcare is growing rapidly. Remote patient monitoring (RPM) is one of the common healthcare applications that assist doctors to monitor patients with chronic or acute illness at remote locations, elderly people in-home care, and even hospitalized patients. The reliability of manual patient monitoring systems depends on staff time management which is dependent on their workload. Conventional patient monitoring uses invasive approaches which needs skin contact to monitor health status. This work carried out a comprehensive review of RPM systems including adopted advanced technologies. The results of this reviewed work show that AI-enabled RPM architectures have transformed healthcare monitoring applications because of their ability to detect early deterioration in patients' health, personalize individual patient health parameter monitoring using federated learning, and learn human behavior patterns using techniques such as reinforcement learning.

Ruqiang et al. (2021), worked on AI-Enabled Monitoring, Diagnosis & Prognosis. The work stated that emerging and development of Artificial Intelligence (AI) particularly deep learning, has encouraged its application in various engineering domains. Monitoring, diagnosis and prognosis, as the key elements of intelligence maintenance of manufacturing systems in the era of Industry has also benefited from the advancement of AI technology. The main objective of this issue is to bring scholars to display their research findings in the fled of monitoring, diagnosis and prognosis driven by AI, and promote its application in intelligent maintenance of manufacturing system.

METHODOLOGY

The methodology adopted in this work is to review related works on ccontrolling sub-Sahara African Agricultural resources for sustainable development with the use of artificial intelligence based monitoring assistive technology (AIBMAT*)*. We analyze the difficulties faced by the agricultural development and agencies in securing African agricultural activities against illegal human activities. The effectiveness of artificial intelligence as an assistive monitoring technology device was observed. It was discovered that that Sub-Sahara Africa's agricultural activities are spectacular for its diversity which surpassing that of many other places in other continents. Preserving these resources becomes imperative. The presence of forest reserve and wildlife conservation in Africa and their unique habitats invites the tourists

and wildlife enthusiasts to the continent. Africa's agricultural resources has been seen as a valuable community asset, and has been protected by different means. The value of agricultural resources occurs for economic, ecological, medicinal, educational, scientific, recreational and intrinsic reasons. It provides employment and contributes to the national incomes of many countries through earnings from agricultural development agencies and the sale of agricultural products. Monitoring this resources against illegal human activities with the use of Artificial Intelligence based assistive technology in this era of technology is the best idea.

Climate Change and the Challenges of Agricultural Resources Conservation in Sub-Sahara Africa

Forest reserve is a key to controlling of climate change; climate change has brought about diverse natural happenings such as global warming and several other occurrences. Africa has forests and woodlands with wide varieties of wide life (Adewumi et al. 2018). The continent is home to biodiversity and vegetation in the region range from rainforest, savanna grasslands and desert. The wood lands and forests in Africa consist of wide species of plants, mammals, birds reptiles and aquatic animals. There are various species of plants, mammals, birds, reptiles and aquatic animals in Africa. Africa forest and wildlife is also famous in the Sub-Sahara Africa, Central Africa most especially the Congo Basin and South Africa. The forests in Africa are mostly tropical and savanna type. The forests are home to diverse mammals, reptiles, birds and aquatic animals. The forest and some species of animals are constantly endangered by illegal human activities. Government at different levels and various forest and wildlife agencies are making efforts to conserve and preserve them. In this era of technology the use of monitoring artificial intelligence would be of necessity. At the present time, forest reserves form a considerable part of Africa. Many of these forest reserves are too small to be of much importance for wildlife protection, but some of the larger forest reserves are the main refuges of many species of animals which are very rare or have been exterminated elsewhere. In the forest reserves, the exploitation of the trees are the main consideration, but the absence of hunting and illegal human activities had a beneficial effect on the forest and wildlife populations.

Strategies for Agricultural Resources Preservation in Africa

Africa's agricultural resources is very spectacular for its abundance and diversity which surpassing that of many other places on earth. Preserving these valuable resources becomes highly imperative. Due to its value, it has been protected conventionally to check-mate illegal human activities. Despite these protection illegal human activities is still going unnoticed. The use of artificial intelligence based monitoring assistive technology can be of great advantage to put these illegal human activities on check. Agricultural Resources provide employment and contributes to the national incomes of many countries through earnings from tourism and the sale of agricultural products (Bridget, 2018). It plays an essential role on the controlling of climate change, African savannas recreation and promoting diversification of ecosystems. Monitoring the Sub-Sahara African Agricultural resources with the use of (AIBMAT) is

highly needed. From table 1(Thanveer et al. 2022), if human activity could be monitored in the hospital with the use of human activity recognition with artificial intelligence it can also be used to monitor human activities in the Agricultural sector.

Table1 Human activity recognition with artificial intelligence. source: Thanveer et al. 2022.

Applications	Algorithm	Technology	References
Physical Activities Monitoring	SVM, RF, KNN, naive Bayes, decision tree, adaptive boosting	Sensors, RFID Tags	Pan et al. (2020), Hsieh et al. (2021), Y. Wang and Zheng (2018), Zhu et al. (2017); Z. Wang et al. (2019)
	KNN, SVM, LSTM, CNN, HACNN	Wearable accelerometer, cloud, fog, edge	Salah et al. (2022), S. Yu et al. (2021)

Agricultural Activities Monitoring Architecture (AAMA)

To effectively control climate change in Africa, remote agricultural activities monitoring (RAAM) is a highly needed if African Agricultural conservation would be effective. The use of Agricultural resources monitoring artificial intelligence in the farms will go a long way to assist the Agricultural activities monitoring teams. RAAM can be used to measure vital signs and activities in the farmt or other physiological parameters such as motion recognition that can help to detect the intruders in the forest ant wildlife. Figure 3 shows Patient monitoring architecture. This architecture can also be designed to monitor the activities in the Agriculture farms. This will go a long way to protect and preserve the agricultural resources deposited in sub-Sahara Africa.

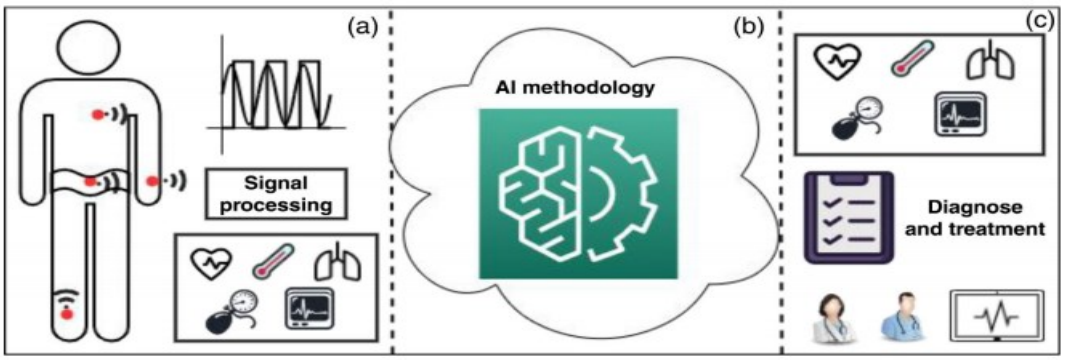


Figure 3 Patient monitoring architecture (inspired by Shao et al., 2020).
Source: Thanveer et al. 2022.

Discussions

Africa's agricultural resources conservation has been seen as a valuable asset to control climate change, and has been protected by different means. The value of agricultural resources cut across climate change control, economic, ecological, medicinal, educational, scientific, recreational and intrinsic reasons. It provides employment and contributes to the national incomes of many countries through earnings from wildlife tourism and the sale of agricultural products. The effect of human activities on sub-Sahara African agricultural resources growth

and development calls for the training of the resources explorers most especially on the use of Artificial Intelligence based monitoring Assistive Technology for monitoring, managing, protecting and preserving these resources which among other things will help to control climate change.

Summary

This research work has established the necessity of using artificial intelligence based monitoring assistive technology to monitor, manage, preserve, protect and promote African agricultural resources, .the reviewed works showed that the technology approaches to agricultural resources conservation that have been described will achieved a great successes to promote climate change control. And the use of forest monitoring artificial intelligence will play an important role in Africa agricultural resources biodiversity conservation strategies. Agricultural activities managements all over Africa who also believe in the protection of agricultural resources advocates should take the use of artificial intelligence based monitoring assistive technology.

Conclusion

Africa is blessed with a very rich and unique array of ecosystems and great variety of Agricultural resources, but the conservation of these resources remains topic of discussion (Adewumi et al. 2018). These challenges cut across bush burning, overgrazing, inconsistency of policies guiding agricultural resources conservation, lack of funds to promote agricultural resources conservation from the government at all levels, Lack of experienced and trained agricultural activities monitoring personnel; hunting of game resources, illegal procurement of protected agricultural resources, game and logging activities, lumbering and other illegal human activities across African forest. These challenges facing the sustainability of forest reserve and wildlife conservation and management in Africa could be get rid of with the use of artificial intelligence based monitoring assistive technology.

Recommendations

To encourage the protection, preservation and promotion of Agricultural resources in Africa the following recommendation should be considered:

- **a.** Workshop / seminar should be designed on the use of artificial intelligence monitoring assistive technology to monitor the illegal human activities..
- **b.** Government at all level should establish a policy that will support the use of artificial intelligence based monitoring assistive technology to monitor the illegal human activities..
- **c.** Well trained personnel should be employed to monitor the agricultural activities being carried out in the sub-Sahara Africa.
- **d.** More agricultural resources conservation should be established and the existing ones should be maintained.

References

Adewumi, A.A, Idowu, E.O and Oyeniran, B.H (2018): Issues, Challenges And Strategies Of Wildlife Conservation In Nigeria, International Journal of Life Sciences Research, 6(2): (37-44).

Agboola, O. and Emmanuel, M, (2016): Awareness of Climate Change and Sustainable Development among Undergraduates from two Selected Universities in Oyo State, Nigeria, World Journal of Education, 6(3): 70-81.

Anthony, V. (2021): Using Big Data and AI for Smarter Mineral Exploration, is based on the exploration round table: How big data can lead to big new discoveries which took place at the Progressive Mine Forum in Toronto, Canada. The one-day mining and exploration innovation event was organized by The Northern Miner, with the support of IBM and other sponsors.

Bridget, B.U. (2018): Strategies for wildlife management in Africa: Actors, successes and failures, pp. 382-408.

Davenport, T.; Kalakota, R. (2019): The potential for artificial intelligence in healthcare. Future Healthc.(6): 94–98.

Ersin E., Nour M., Zakwan A., Aymen I. Z., Elda C., Greeshma V., Ahmed S., Ahmet E. T.,

Wiem A., Shinu M., Chamseddine Z. (2023): Artificial Intelligence Technology in the Agricultural Sector: A Systematic Literature Review. Journal of Institute of Electrical and Electronic Engineering (IEE) Vol. 11(1), pp. 171-202…00

Krishna, K.R. (2023): Stress phenotyping in plants using articial intelligence and machine learning Journal of Agriculture and Livestock Farming VOL. 1(1), pp. 1-2

Michael K.S., Fredrick M.A.and Benard M. (2021): Adoption of Artificial Intelligence in Agriculture in the Developing Nations: A Review. Journal of Language, Technology & Entrepreneurship in Africa (JOLTE) Vol. 12(2), pp. 1-21

Ojuope K.I., Chris-Alofe M.F., Salawu S.A. (2023): Managing Sub-Sahara African Forest and Wildlife Reserved Resources for Controlling Climate Change with the use of Information Technology Based Forest Monitoring Artificial Intelligence (ITb/FMAI). Journal of African Advancement and Sustainability Studies (JAASS). 29(2), pp. 105-112. September, 2023 Edition.

Olivier, D., Saıd, M.,, Sidi, A. M., Pierre, M., Jerome, B. and Frederic. (2020): Edge Computing and Artifificial Intelligence for Real-time Poultry Monitoring, International Workshop on Artifificial Intelligence & Internet of Things (A2IoT) August 9-12, 2020, Leuven, Belgium, Procedia Computer Science 175 (2020): pp. 534–541.

Ruqiang, Y., Xuefeng, C., Weihua, L. and Robert, X. G. (2021):AI-Enabled Monitoring, Diagnosis & Prognosis, Chinese Journal of Mechanical Engineering, Springer Open Journal, *(2021): 34:68*

Tanha T., Dhara S., Nivedita P., Hiteshri Y., Manan S. (2020): Implementation of artificial ntelligence in agriculture for optimisation of irrigation and application of pesticides and herbicides. Journal opf artificial Intelligence in Agriculturel Vol. 11(1). Pp, 58-73.

Thanveer, S., Xiaohui, T., Niall, H., Lin, L., Raj, G., Xujuan, Z. and U. R. A. (2022): Remote patient monitoring using artificial intelligence: Current state, applications, and challenges, Wiley Online Library, DOI: 10.1002/widm.1485. pp. 1-11.