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ARTIFICIAL INTELLIGENCE AND FARMING SECURITY IN ANAMBRA STATE, NIGERIA

Bankole Isaac, AKINROLUYO (PhD)
bi.akinroluyo@unizik.edu.ng

Dimgba Chidinma Martha (PhD)
cm.dimgba@unizik.edu.ng

Okeke Obianuju Anthonia
oa.obianuju@unizik.edu.ng

Nnamdi Azikiwe University Awka, Anambra State.

Abstract

This study explored the relationship that exists between Artificial Intelligence and farming security in Anambra State. Descriptive research design was adopted for this study and population consisted of 163 employee of Coscharis farm Igbariam, Anambra State and Taro Yamane was adopted to determine the sample size of 116 as respondents of the study. Primary data was used to gather the information needed through questionnaire and linear regression method to test the Hypotheses at 5% level of significance. The result from the study claimed that Drone technology allows for more precise monitoring of crop health, weed and pest infestations, soil conditions, and other farm products as well as smart fence has reduced the rate of theft in the farm. Also, the farm adopted the use of facial recognition technology and prevent unauthorised person from entering the farm which contribute to high security level of the farm. Result from the hypotheses revealed that there is positive relationship between use of drone, facial recognition technology and market sustainability as well as positive relationship between adoption of smart fencing technology and market sustainability of the farm in Coscharis Farm Igbariam, Anambra state. The study concluded that there is strong and positive relationship between drone, facial recognition and market sustainability of farm produce in Coscharis farm Igbariam, Anambra state. The study affirmed that smart fencing contributes positively and significantly related to the market sustainability. The study recommended that there is need for farm managers not to allow the cost of Artificial Intelligence tools to affect their return on investment.

Keywords: Artificial Intelligence, Farming Security, Market Sustainability and Drone

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Introduction

Agriculture is a vital sector in Anambra State, Nigeria, employing over 70% of the population (National Bureau of Statistics, 2020; Anambra State Government, 2020) and contributing significantly to the state's economy, with a gross domestic product (GDP) of ₦3.8 trillion in 2020 (Anambra State Government, 2020). However, farming in Anambra State faces numerous challenges, including low yields (Food and Agriculture Organization, 2019; National Agricultural Extension and Research Liaison Services, 2019), limited access to markets (International Fund for Agricultural Development, 2019; Anambra State Ministry of Agriculture, 2020), and inadequate use of technology (Anambra State Ministry of Agriculture, 2020; Digital Agriculture Alliance, 2020). The state has a total land area of 4,844 square kilometers, with 2,500 square kilometers suitable for agriculture (Anambra State Government, 2020; National Bureau of Statistics, 2020). The main crops grown in Anambra State include cassava, rice, maize, and yams (Anambra State Ministry of Agriculture, 2020; Food and Agriculture Organization, 2019). Despite its agricultural potential, Anambra State faces challenges in terms of agricultural productivity, with crop yields below national averages (National Agricultural Extension and Research Liaison Services, 2019; Food and Agriculture Organization, 2019).

Artificial intelligence (AI) has the potential to transform the agricultural sector in Anambra State by improving crop yields, disease detection, and irrigation management (Precision Agriculture Alliance, 2020; University of California, Davis, 2019; Irrigation Association, 2020). AI can also enhance the livelihoods of smallholder farmers, who are the backbone of agriculture in the state (International Labour Organization, 2019; Precision Agriculture Alliance, 2020). Artificial Intelligence (AI) stands at the forefront of technological innovation, reshaping industries, economies, and societies worldwide. Its remarkable capabilities in mimicking human intelligence, learning from data, and making autonomous decisions have propelled AI to the forefront of research and development across various domains. Farming security is a critical aspect of agricultural sustainability and food production, encompassing the protection of farms, crops, livestock, and agricultural infrastructure from various threats and risks. In recent years, the importance of farming security has become increasingly evident as farmers face a growing array of challenges that undermine their livelihoods and jeopardize food security.

The agricultural sector in Coscharis Farm Igbariam Anambra State, Nigeria, faces numerous security challenges, including crop theft, disease outbreaks, and pest infestations, which result in significant economic losses and food insecurity (Adebayo, 2020; Eze, 2017; Olawoye, 2020; Oduoye, 2019; Ajayi, 2018). The traditional methods of farming and security measures in place are inadequate to address these challenges, and the state's agricultural productivity continues to decline (Eze, 2017). Artificial Intelligence (AI) has the potential to revolutionize farming and enhance security, but its adoption in Coscharis Farm Igbariam Anambra State's agricultural sector is limited (Olawoye, 2020). Furthermore, the lack of effective crop monitoring and prediction systems, inadequate farmer education and training, and limited access to credit and insurance facilities exacerbate the security challenges faced by farmers in the state (Adebayo, 2020; Oduoye, 2019; Ajayi, 2018). Therefore, this study aims to explore the application of AI in enhancing farming security in Coscharis Farm Igbariam Anambra State, Nigeria. However the Specific objectives are to: ascertain the degree of relationship that exists between drone and market sustainability of farm produce in Coscharis Farm Igbariam, Anambra State, determine the extent of relationship that exists between facial recognition and market sustainability of farm produce in Coscharis farm Igbariam , Anambra State, identify the level of relationship that exists between smart fencing

and market sustainability of farm produce in Coscharis Farm Igbariam , Anambra State.

Literature Reviews

Artificial Intelligence

Artificial Intelligence (AI) refers to the simulation of human intelligence processes by machines, particularly computer systems. These processes include learning (the acquisition of information and rules for using the information), reasoning (using rules to reach approximate or definite conclusions), and self-correction. Key subfields of AI include machine learning, natural language processing, robotics, and computer vision. AI applications span numerous industries and sectors. In healthcare, AI is used for diagnostics, personalized treatment plans, and predictive analytics to anticipate patient outcomes (Topol, 2019). In finance, AI algorithms are employed for fraud detection, risk management, and automated trading (Bhardwaj et al., 2020). The transportation sector uses AI for developing autonomous vehicles, optimizing traffic management, and improving logistics (Litman, 2020). Agriculture benefits from AI through precision farming techniques that enhance crop monitoring, soil management, and predictivemaintenance of machinery (Liakos et al., 2019). AI also plays a crucial role in smart cities, improving infrastructure management, energy distribution, and public safety (Yigitcanlar et al., 2020).

Despite its potential, AI faces several significant challenges. Ethical concerns are at the forefront, with issues related to bias, fairness, and transparency in AI decision-making processes (Jobin et al., 2019). Data privacy and security are critical, as AI systems often require large datasets, some of which may contain sensitive personal information (Mühlhoff, 2019). Moreover, the need for extensive computational resources and expertise poses a barrier to widespread AI adoption (Strubell et al., 2019). There are also concerns about job displacement due to automation and the societal impact of AI on employment (Brynjolfsson & McAfee, 2019). The future of AI is poised to see further advancements in autonomous systems capable of performing complex tasks with minimal human intervention. Efforts are ongoing to develop general AI, which would exhibit broader cognitive abilities similar to human intelligence (Goertzel, 2019). Ethical AI development, emphasizing transparency, accountability, and fairness, will be crucial. Robust regulatory frameworks and international cooperation will also play significant roles in ensuring the responsible deployment of AI technologies (Floridi et al., 2019). Advances in AI are expected to further integrate with other emerging technologies like the Internet of Things (IoT) and blockchain, enhancing their capabilities and applications (Mamoshina et al., 2021).

Farming security

Farming security encompasses various measures to protect agricultural assets, including crops, livestock, equipment, and data, from threats such as theft, vandalism, pests, diseases, and cyber-attacks. With the increasing reliance on technology in agriculture, ensuring the security of physical and digital assets has become a critical concern.

Farming security is a critical concern in the agricultural industry, as farms and ranches face various threats such as theft, vandalism, and terrorism (Horton, 2019). Recent advancements in technology and surveillance systems have improved farming security (Anderson, 2019). Best practices for farm security include implementing physical barriers, monitoring systems, and emergency preparedness plans (Farm Security Coalition, 2020). Cybersecurity is also a growing concern in agriculture, and farmers must be aware of the risks and take steps to protect their operations (Miller, 2020). The use of drones and artificial intelligence can

enhance farm security (Roka, 2020). Collaboration between law enforcement and the agricultural industry is crucial to address farm security issues (Farm Bureau, 2021). Surveillance systems, such as cameras and sensors, can also aid in detecting and preventing security breaches (Wright, 2021). Furthermore, the USDA provides resources and guidance on farm security and emergency preparedness (USDA, 2020).

Theoretical Framework

Social Cognitive Theory (SCT)

Social Cognitive Theory (SCT), developed by Albert Bandura, is a framework for understanding, predicting, and changing human behavior. It emphasizes the dynamic and reciprocal interaction of personal factors, environmental influences, and behavior. SCT is widely used in various fields, including psychology, education, communication, and health sciences.

Social Cognitive Theory (SCT) explains how individuals learn and adopt new behaviors, including the use of artificial intelligence (AI) for farming security. SCT posits that learning is a cognitive process that takes place in a social context, and that individuals learn by observing others, imitating behavior, and reinforcing their own behavior through rewards or punishments.

Empirical Reviews

Cavalcante de Oliveira, and Diogne de Souza e Silva (2023) investigated the evolution of AI in agriculture over the last five years, focusing on technologies like machine learning, IoT, and robotics. In summary, the study concludes that AI has the potential to revolutionize agriculture, making it more efficient, productive, and sustainable. However, overcoming existing challenges and ensuring equitable access to AI technologies are essential for realizing these benefits on a global scale.This includes fostering collaborations between governments, academic institutions, and the private sector to ensure that AI technologies benefit all stakeholders in the agricultural ecosystem.

Chukwu (2020) investigated the study on Preventing Crop Theft with AI Technologies. Farms that implemented AI technologies experienced a significant reduction in crop theft incidents, with an average decrease of 45% in reported thefts within the first year of adoption.AI-basedsurveillance systems provided real-time monitoring of farm perimeters and generated instant alerts when suspicious activities were detected, allowing for quick responses to potential theft.AI technologies are highly effective in preventing crop theft, providing substantial improvements in security and reducing the incidence of theft on farms.

Sharma, Kumar, and Bhardwaj (2019) examined how to evaluate the effectiveness of AI-driven surveillance systems in farm security. Farm security has become increasingly important due to the rising incidences of theft, vandalism, and unauthorized access. Traditional security measures often fall short in providing comprehensive and proactive protection. With advancements in technology, AI-driven surveillance systems have emerged as a promising solution to enhance farm security.

Jha, (2019) examined the automation of agricultural practices using AI technologies. The automation of agricultural practices using AI technologies has the potential to revolutionize farming by increasing efficiency, productivity, and sustainability. While there are challenges to be addressed, the ongoing advancements in AI present significant opportunities for the future of agriculture.Despite the benefits, there are challenges in implementing AI in agriculture. These include the high initial costs of AI technologies, the need for technical

expertise, and the accessibility of these technologies to small-scale farmers.

Methodology

The study will adopt a descriptive research design which plays a big role in business research. The descriptive research design addresses the questions posed by exploratory research offering solutions to different business issues. The target population for this study comprised 164 employees of Coscharis Farm Igbariam, Anambra State. The study made use of Yamane (1967) formula to get sample size of 116. This study will make use of random sampling technique to select respondents for the study. The data collected from the respondents with the aid of questionnaire were analysed using descriptive and inferential statistics. Demographic data were analysed statistics using descriptive while research questionnaire were answered using both descriptive and inferential statistics such as mean, standard deviation and percentage. Hypotheseses were analysed using Pearson correlation analyses at a 0.05 level of significance.

Data Analyses

Test of Hypotheses

Hypothesis One

H01. There is a significant positive relationship between the use of drones and market sustainability of farm produce in Coscharis farm, Igbariam, Anambra State.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.558[a]	.311	.303	.70344

a. Predictors: (Constant), use of drones

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	19.217	1	19.217	38.836	.000[b]
	Residual	42.556	86	.495		
	Total	61.773	87			

a. Dependent Variable: market sustainability
b. Predictors: (Constant), use of drones

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.739	.346		5.032	.000
	use of drones	.580	.093	.558	6.232	.000

a. Dependent Variable: market sustainability

From the table above, R is the square root of R-square and is the correlation between the observed and predicted value of the dependent variable market sustainability and the independent variable use of drones as well as adjusted R square with the standard error of the

estimate. Furthermore, the coefficient determination of (R^2) with the value 0.311 indicates use of droneaccount for 31% variation in market sustainability of the farm. The F-value which is obtained by the Mean Square Regression (19.217) divided by the Mean Square Residual (0.495), yielding F = 38.836. In the first hypothesis, the independent variable (use of drone) was found to have significantly predicted the dependent variable (market sustainability). Therefore, the test of use of droneon market sustainability of the farm is significant at 0.000 p-values. Therefore, the null hypothesis is thereby rejected.

The table above also revealed that there is positive relationship between use of droneand market sustainability. This shows that use of drones will lead to prefer market sustainability. This is show by the coefficient of the variable with the value 0.580 which means that 1% increase in use of drones will lead to 58% increase in market sustainability. The reason here meant that if the manager of the farm ensures accurate use of drones, the farm will experience more productivity with use of drones. However, the study revealed that the predictor variable used of drone by the farm manager will predicts market sustainability with ($\beta = 0.558$; $t = 6.232$; $p<0.05$). Therefore, the null hypothesis is rejected in favour of alternative hypothesis.

Hypothesis Two

H02. There is a significant positive relationship between the implementation of facial recognition technology and market sustainability of farm produce in Coscharis farm, Igbariam, Anambra State.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.544[a]	.296	.288	.71107

a. Predictors: (Constant), implementation of facial recognition technology

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	18.289	1	18.289	36.171	.000[b]
	Residual	43.484	86	.506		
	Total	61.773	87			

a. Dependent Variable: market sustainability
b. Predictors: (Constant), implementation of facial recognition technology

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.428	.408		3.496	.001
	implementation of facial recognition technology	.674	.112	.544	6.014	.000

a. Dependent Variable: market sustainability

From the table above, R is the square root of R-square and is the correlation between the observed and predicted value of the dependent variable market sustainability and the independent variable implementation of facial recognition technology as well as adjusted R square with the standard error of the estimate. Furthermore, the coefficient determination of (R^2) with the value 0.296 indicates that implementation of facial recognition technology account for 30% variation in market sustainability of the farm. The F-value which is obtained by the Mean Square Regression (18.298) divided by the Mean Square Residual (0.506), yielding F = 36.171. In the hypothesis, the independent variable (implementation of facial recognition technology) was found to have significantly predicted the dependent variable (market sustainability). Therefore, the test of implementation of facial recognition technology on performance of farm is significant at 0.000 p-values. Therefore, the null hypothesis is thereby rejected.

The table above also revealed that there is positive relationship between implementation of facial recognition technology and market sustainability. This shows that implementation of facial recognition technology will lead to prefer market sustainability. This is show by the coefficient of the variable with the value 0.674 which means that 1% increase in implementation of facial recognition technology will lead to 67% increase in market sustainability. The reason here meant that if the management of the farm ensure adequate implementation of facial recognition technology, the farm will experience more performance from use of artificial intellegence. However, the study revealed that the predictor variable of facial recognition technology the farm will predicts market sustainability with ($\beta = 0.544$; $t = 6.014$; $p<0.05$). Therefore, the null hypothesis is rejected in favour of alternative hypothesis.

Hypothesis Three

H03. There is a significant positive relationship between the adoption of smart fencing technology and market sustainability of farm produce in Coscharis farm, Igbariam, Anambra State.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.517[a]	.267	.259	.72536

a. Predictors: (Constant), adoption of smart fencing technology

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	16.524	1	16.524	31.404	.000[b]
	Residual	45.249	86	.526		
	Total	61.773	87			

a. Dependent Variable: Market sustainability
b. Predictors: (Constant), adoption of smart fencing technology

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.126	.316		6.737	.000
	adoption of smart fencing technology	.416	.074	.517	5.604	.000

a. Dependent Variable: market sustainability

From the table above, R is the square root of R-square and it's the correlation between the observed and predicted value of the dependent variable market sustainability and the independent variable adoption of smart fencing technology as well as adjusted R square with the standard error of the estimate. Furthermore, the coefficient determination (R^2) with the value 0.267 indicates that adoption of smart fencing technology account for 26% variation in market sustainability.

The F-value which is obtained by the Mean Square Regression (16.524) divided by the Mean Square Residual (.526), yielding F = 31.404. In the hypothesis, the independent variable (adoption of smart fencing technology) was found to have significantly predicted the dependent variable (market sustainability). Therefore, the test of adoption of smart fencing technology on market sustainability is significant at 0.000 p-values < 0.05. The null hypothesis is thereby rejected.

The table above also revealed that there is positive relationship between adoption of smart fencing technology and market sustainability of the farm. This is show by the coefficient of the variable with the value 0.416 which means that 1% increase in adoption of smart fencing technology will lead to 41% increase in market sustainability. The means that continued practice of effective adoption of smart fencing technology by the management of the farm will result in performance improvement on the market sustainability.

Discussion of Findings

From the result of the findings, Smart fence has reduced the rate of theft in the farm and this is in support of the study by Chukwu (2020)who investigated that on preventing Crop theft with AI Technologies. Also the result disclosed that Smart fencing contribute to increase level of sustainability of the farm and the findings is in line with Uche (2021)examined the study on AI and promotion of sustainable farming practices. The outcome from the study disclosed that facial recognition help in effective monitoring of crop and livestock diseases. This findings is in line with Mutanga (2017) who investigated the impact of AI in managing crop diseases and pests, highlighting the improvements in crop yield and quality.More so, the result discovered that Smart fence has improved the security of the farm for both livestocks and farm produces which is in agreement with Chukwu and Nwosu (2023) & Adewale and Okafor (2022) who concluded that the impact of AI-driven solutions contribute to livestock security in Nigerian farms. The study revealed that there is positive relationship between adoption of smart fencing technology and market sustainability of the farm as (p-value = 0.00 < 0.005)which is supported by Nweke (2023) who found out that AI-integrated smart fencing solutions significantly reduced unauthorized access to farms

Summary of findings

There is a significant relationship between the use of drones and market sustainability of farm produce in Coscharis farm, Igbariam, Anambra State, that is, a 55% change in market sustainability is as a result of changes in the use of drones (R=.558, R-square=.311, P-value<0.05).

There is a significant relationship between facial recognition technology and market sustainability of farm produce in Coscharis farm, Igbariam, Anambra State, that is, a 54% change in market sustainability is as a result of changes in the use of facial recognition (R=.544, R-square=.296, P-value<0.05).

There is a significant relationship between smart fencing technology and market sustainability of farm produce in Coscharis farm, Igbariam, Anambra State, that is, a 51% change in market sustainability is as a result of changes in smart fenc (R=.517, R-square=.267, P-value<0.05).

Conclusion

The study on artificial intelligence (AI) and farming security in Coscharis Farm Igbariam Anambra State reveals that AI plays a crucial role in ensuring farm security. The integration of AI technologies allows for more precise monitoring of crop health, weed and pest infestations, soil conditions, and other farm products, as well as providing access to hard-to-reach areas and operating in conditions unsuitable for ground-based spraying equipment. Additionally, artificial intelligence helps farmers prevent unauthorized persons from entering the farm, which contributes to a high security level of the farm and effective monitoring of crop and livestock diseases. Furthermore, artificial intelligence reduces the rate of theft on farms and contributes to a higher level of sustainability of farms.

Recommendations

1. To ensure effective monitoring of crop health, weed and pest infestations, farms managers should continuously adopt the use of drone's technologies.
2. Farmers should invest in and integrate smart fencing, as this helps to prevent unauthorized persons from entering the farm.
3. To reduce the rate of theft on farms and ensure sustainability, farmers should adopt the use of facial recognition technologies.

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