ADOPTION OF DRONE TECHNOLOGY FOR EFFECTIVE FARM MANAGEMENT AND ADEQUATE FOOD AVAILABILITY: THE PROSPECTS AND CHALLENGES

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ABSTRACT

This study was to assess the prospect and challenges of adopting drone technology for effective management and adequate food availability. Correlational survey design was adopted for the study. The study was conducted in South-South Nigeria. The population of the study consisted of agriculturalists in South-South Nigeria. Stratified sampling technique was used in selecting 30 agriculturalists in each of the states in the South-South Nigeria. This gave a total of 180 sample sizes used for the study. The instrument used in this study for data collection was a questionnaire titled "Drone Technology for Effective Farm Management and Adequate Food Availability Questionnaire (DTEFMAFAQ)". Face and content validation of the instrument was carried out by an expert in testing, measurement, and evaluation to ensure that the instrument has the accuracy, appropriateness, and completeness for the study under consideration. The reliability coefficient obtained was 0.80, and this was high enough to justify the use of the instrument. The researcher subjected the data generated for this study to appropriate statistical techniques such as percentage analysis. The test for significance was done at 0.05 alpha levels. The study concluded that drones are remotely piloted aircraft systems without a human pilot aboard. The drone used for agricultural activities is known as the "agriculture drone. It is mainly used to assist in crop production and to monitor crop growth. In many areas, drone use has become an essential part of large-scale precision farming operations. One of the recommendations made was that the use of drones should be implemented in farm management activities to increase crop yields and food availability for the masses.

KEYWORDS: Drone Technology, Farm Management, Adequate Food Availability.

Introduction

Drones are the most common names, as in the early years they were known as flying robots (Dalamagkidis, Valavanis, and Piegl, 2012). A formal description of drones is an unmanned aircraft system that is remote-controlled and pilotless. As the drone soars up in the air, the best thing about drones is that they are flying without any humans or people inside controlling it. The human pilot that controls the drone with an onboard computer on land is sometimes called an operator (Newcome, 2004). Drones are named after honeybee drones, which perform their tasks unconditionally (mindlessly) because they are controlled by a powerful queen far away (Joiner, 2018). Amazingly, the drone works the same way as the bees as they are microcontroller programmed by the operator to be on autopilot, and the innovation of the drone keeps expanding with the aid of technology.

According to My Agriculture Information Bank (2018), farm management is that branch of agricultural economics which deals with the business principles and practices of farming with the object of obtaining the maximum possible return from the farm as a unit under a sound farming programme. Farm management may be called a science of decision making. Therefore, it can be defined as a science which deals with judicious decisions on the use of scarce farm resources, having alternative uses to obtain maximum profit and family satisfaction on a continuous basis from the farm as a whole. According to Warren cited in My Agriculture Information Bank (2018), farm management is the study of the business principles of farming. It may be defined as the science of organization and the management of the farm enterprise for the purpose of securing the greatest continuous profits.

The main source of food availability for the population of the world is agriculture. The term agriculture, as broadly used here, also includes livestock husbandry, managed fisheries (aquaculture) and forestry. The composition of meals changes gradually as demand for food strengthens and lifestyles change. For those that can afford it, many products that are grown out of season or are exotic now appear on their local market. What agriculture produces is driven by consumer demand, and changes in consumer preferences have an influence on the amount of water needed for food production (FAO, 2003).

Statement of Problem

The definition of farm management suggests that management is a problem-solving and decision-making activity. Farm managers face problems and challenges during farm management. Some of the problems could be the fact that farmers have to work long hours and be on-site for most hours of the day. They are required to do things such as planting, seeding, harvesting, and weeding in order to make sure that their crops grow well. There is very little time off for these farmers because they need to constantly monitor their crops with a watchful eye in order to prevent any problems. This can be very tiring and stressful, but it is all part of the job. The farmers also face issues predicting the weather conditions. Pests and weeds are also a major challenge to farm managers. This is because pests destroy the cash crops of the farm, thereby causing a loss to the farmer. Weeds compete with cash crops for nutrients and sunlight. The control of these pests and weeds becomes a challenge for farm managers. It then becomes more problematic when dealing with a large piece of land. A farm management operation becomes more tedious for the farmer. If the farm management process faces such major challenges, it is bound for the aspect of adequate food availability to be equally affected based on the fact that the farm is the primary source of food production.

Objective of the Study

1. To determine the impact of drone technology on effective farm management.
2. To find out the impact of drone technology on adequate food availability.

Research Questions

1. What is the impact of drone technology on effective farm management?
2. What is the impact of drone technology on adequate food availability?

Hypotheses

1. There is no significant influence of drone technology on effective farm management.
2. There is no significant influence of drone technology on adequate food availability.

Conceptual Review

Concept of Drone Technology

According to RF Wireless World (2012), a small aircraft that operates on its own without any human beings is known as an Unmanned Aerial Vehicle. It is also referred to by its abbreviation, UAV. It is popularly known as the Drone. Drones are remotely piloted aircraft systems without a human pilot aboard. UAVs are a component of an unmanned aircraft system (UAS), which includes a UAV, a ground-based controller, and a system of communications between the two. The flight of UAVs may operate with various degrees of autonomy, either under remote control by a human operator or autonomously by on-board computers. A typical unmanned aircraft is made of light composite materials to reduce weight and increase manoeuvrability. This composite material strength allows military drones to cruise at extremely high altitudes. Drones are equipped with different state-of-the-art technologies such as infra-red cameras (military UAV), GPS, and lasers (military UAV). Drones can be controlled by a remote control system or a ground cockpit. Drones come in a wide variety of sizes, with the largest drones mostly used for military purposes, such as the predator drone and other smaller drones which can be launched by hand, as well as other unmanned aircraft which require short runways. An unmanned aerial vehicle system has two parts: the drone itself and the control system. All the sensors and navigational systems are present in the nose of the unmanned aerial vehicle. The rest of the body is a complete innovation since there is no loss of space to accommodate humans and also light weight (Corrigan, 2020). The engineering materials used to build the drone are highly complex composites that can absorb vibration, which reduces the noise produced.

The drone used for agricultural activities is known as the "agriculture drone." It is mainly used to assist in crop production and to monitor crop growth. In many areas, drone use has already become an essential part of large-scale precision farming operations. The data collected from drones recording fields helps farmers plan their planting and treatments to achieve the best possible yields. Some reports indicate that using precision farming systems can increase yields by as much as 5%, which is a sizeable increase in an industry with typically slim profit margins (Croptracker, 2022).

Concept of Farm Management

Farm management is the process of making and implementing the decisions involved in organising and operating a farm for maximum production and profit. Farm management draws on agricultural economics for information on prices, markets, agricultural policy, and economic institutions such as leasing and credit. According to Bliss (2021), it also draws on plant and animal sciences for information on soils, seed, and fertilizer; on control of weeds, insects, and disease; and on rations and breeding; on agricultural engineering for information on farm buildings, machinery, irrigation, crop drying, drainage, and erosion control systems; and on psychology and sociology for information on human behaviour. A farm manager thus integrates information from the biological, physical, and social sciences in making his decisions.

According to Farm Management (2013), farm management is the collective term for various management strategies and methods that are employed to keep a farm productive and profitable. The process of this type of management is often associated with large commercial farms, although many of the same methods can be used with equal success on a small family-owned farm. Depending on the size of the operation, the management process may require the services of a single farm manager or a group of managers who oversee various aspects of the overall project.

Concept of Adequate Food Availability

Adequate food availability refers to the physical availability of food stocks in desired quantities. Physical availability in any location within a nation depends on storage and transport infrastructure and market integration within the national territory. According to FAO (2008), food availability addresses the "supply side" of food security and is determined by the level of food production, stock levels, and net trade. Food production is the basis for food security. Using food grains as a proxy for food (reasonable enough in a context where food grains account for a large share of food intake), the availability of food grain is given by domestic production net of feed, seed, and wastage plus net imports plus draw-down of stocks. The availability of sufficient quantities of food of appropriate quality, supplied through domestic production or imports (including food aid) (Policy Brief, 2006).

The global food supply is not even. Some places produce more food than others. Physical factors (such as climate, soil quality, and gradient) and human factors (such as technology) have historically controlled the quantity and type of food produced in any location. Rainfall is increasing in some places but decreasing in others. Higher temperatures and unreliable rainfall make farming difficult, especially for those farming marginal lands, who already struggle to survive. Even advanced countries (ACs) can be affected by drought. Improvements in technology have increased the amount of food available. Technology can overcome temperature, water, and nutrient deficiencies in the form of greenhouses, irrigation, and fertilizers. This can incur an economic or environmental cost. Advanced countries import food from across the globe all year round. Irrigation systems provide water for countries with unreliable or low rainfall. Irrigation doubles crop yields, but it is expensive to put these systems in place. Water can be taken either from underground aquifers or directly from rivers.

Effective Farm Management Strategies

A "best management strategy" is said to be any method or practice that is technically and environmentally sound and which, when utilised in agricultural crop production, prevents or reduces the common problems related to general agricultural production (CEP Technical Report: 41, 1998). The following section discusses three of the best management practices for agricultural crops, which are the use of cover crops, crop-rotation and intercropping, as well as pesticide and fertiliser management.

The use of cover crops: Cover crops are plants that are grown to stay low on the ground, mostly during the offseason period, to prepare the land for the plantation of cash crops. However, White (2014) opines that cover cropping could also be a second plantation of an un-harvested crop in line with the cash crop. They play a significant role in sustaining agricultural production in farmlands. They improve soil fertility and soil quality, prevent soil erosion (Sharma et al. 2018), as well as nitrogen leaching or runoff (Schonbeck et al. 2017), while improving the quality of water and sustaining microbial biodiversity in the soils (Sharma et al. 2018; Lee, 2016). They supply essential nitrogen that aids in maintaining pH levels and reducing soil compaction. Cover crops are ‘deceitful crops’ used to distract pests from attacking the agricultural cash crops on the farm. Thus, the use of cover crops in agricultural crop plantations is recommended by many agriculturalists as one of the best and most sustainable management practices for agricultural crops.

Crop rotation and intercropping: Crop rotation and intercropping are some of the best agricultural crop management practices that have been used for a long time in organic farming and now in conventional farming (European Pesticide Action Network, 2013). Crop rotation is the agricultural practice of growing different or dissimilar crops on the same farmland in different seasons. On the other hand, intercropping is a multiple cropping system whereby two or more crop species are planted simultaneously on the same farmland in one planting season (Mousavi and Eskandari, 2011). These agricultural crop planting practices assist in varying the set of soil nutrients, thereby reducing the likelihood of soil erosion. Ball, (2005) contends that crop rotation ensures that high quality yields of agricultural crops are harvested with less environmental impact on the general agro-ecosystem. They also contribute positively to the stability of the soil structure, reducing the outbreak of pests, weeds, and other diseases on the farmland (Mousavi and Eskandari, 2011, Riedell, 2019). Crop rotation and intercropping reduce the reliance on chemical fertilizers (Conant, 2009), minimize agricultural crop production dangers (Woodfine, 2009), and increase crop yield in comparison with monoculture practices. A 50-year field experiment in the northern zone of Moldova confirms this hypothesis. Boincean (2012) reports that crop rotation implemented at the study site maximized crop productivity in comparison with monoculture.

Pesticide/Fertilizer management: The use of chemical pesticides on farmlands to boost agricultural crop yields is rampant in many places. However, their use must be done sparingly. They must only be used when it is the last option to protect the agricultural crops from parasites. In most cases, organic fertilization methods such as the use of compost and animal manure (Branca et al. 2011) for nourishing the fertility of the soil must be chosen over the use of chemical pesticides (Menalled, 2008; Sekyere, 2019). Agriculturalists must pay close heed to the selection of a pesticide that has the very least or no impact on the environment. They must critically consider the chemical solubility, volatility, and degeneration characteristics to find out if they would harm the environment or leach easily through the soil. In the use of chemical pesticides, the 'label is the law' (LeBlanc, 2011). What this generally implies is that the application of the chemical as spelt out on the label must be followed meticulously to the latter. They must be correctly applied and used in their proper amounts. Generally, the timing for the application of the pesticide must not be done before rainfall as it is likely to leach or result in runoff that would eventually mar the quality of freshwater. Chemical fertilizers must be well labeled and stored in dry and well ventilated areas where fire-stopping equipment is readily available.

Drone Technology on Effective Farm Management

According to Minhaj (2022), the benefits of drones in agriculture are numerous. It is one of the technologies that drives precision agriculture. Precision agriculture is the science of improving efficiency, productivity, crop yield, and profitability through the use of technology. Some outlined prospects for drone technology on farm management are as follows:

Fast Data Acquisition for Accurate Farm Analysis: Through a method called drone photogrammetry, drones can help farmers and agronomists create highly accurate maps and 3D models of the area. With drone mapping software such as Pix4DFields or Drone Deploy, images captured by drones can be stitched together to get a topographical map of the farmland. Drones can be fitted with different types of cameras like RGB, multispectral, and thermal cameras that will allow farmers to gain access to different forms of data (Minhaj, 2022).

Data from these maps will help farmers make the necessary adjustments to ensure that the land stays healthy and productive. As drones are easy to deploy, farmers can obtain field data as often as they want, which will help them identify problems as soon as they occur and allow them to put together a plan of action and reduce any negative effect these issues may pose.

Time and Cost Saving: One of the main benefits of using smart technology in agriculture is the reduced time it takes to complete many tasks. Drones are much more time-efficient than manned aircraft for things like mapping, surveillance, and crop spraying. Drones are also used to plant seeds, spray crops with water, fertilizers, pesticides, and herbicides. Furthermore, Minhaj (2022) stated that many of these operations can be carried out through intelligent flight modes; they are semi-automated, which results in less time being spent on the field, which saves farmers money on labour equipment.

Improved Crop Yields: Drones allow farmers to obtain crop data fast and frequently. This keeps them on top of things like irrigation issues, plant disease, and soil conditions. All these things need to be in optimal conditions for crops to thrive and farmers to meet crop yield expectations. Through precision agriculture, farmers and agronomists can improve overall crop yield through data-driven variable rate prescription. By using remote sensing technology, farmers will be able to easily identify areas of the field that are not producing healthy crops, find out what the problem is, and only target that area for any treatment that may be required. This will improve the overall quality of the crops, improve yield, and save money in the long term (Minhaj, 2022).

Safer way to Spray Crops: According to Minhaj (2022), pests and plant diseases are always going to be an issue for farmers. Spraying chemicals manually will always pose a health hazard and is very time-consuming and labour-intensive. Using drones to treat infected plants is much safer and more efficient than manual labour and using land-based machinery. Smart drones also come with autonomous flight modes. This will allow farmers to plan flight paths only around areas that need to be treated and leave the healthy parts of the field free from unnecessary chemicals. Not only is this a safer way to treat crops, but farmers will also save money by not wasting treatment on plants that don't need it.

Impact of Drone Technology on Adequate Food Provision

Crop Monitoring: According to Doddamani, Kouser and Ramya (2020), a drone (multispectral eBee SQ) provides a holistic view of a crop's growth, enabling professionals to quickly and precisely identify the issues and target their field scouting. The data gathered from the drones is helpful for facilitating better planning and monitoring improvements like ditches and fertiliser applications. Precision farming integrates sensor data and imagery with real-time data processing to increase farm efficiency by measuring field spatial variability. Data collected through drones is providing the much-needed raw data to enable agricultural analytical models. Drones can monitor soil and crop health in support of precision farming, assist in planning irrigation schedules, efficient fertiliser utilization, estimate yield data, and provide valuable weather analytical data. Vast fields and lower crop control quality together pose the biggest challenge to agriculture. Monitoring during unpredictable weather conditions is very difficult, which makes risk and field maintenance costs increase. Earlier, satellite pictures were used for monitoring, but they have several drawbacks. The image quality is poor for understanding the crop and soil health and could be taken only once a day. Further, due to extremely high service costs, the image quality typically suffers on certain days. Today, with time series animations, it is possible to see the precise development of a crop and reveal inefficiencies in growth, thus enabling better management of crops. A specific algorithm converts the collected raw data by drones into useful and comprehensible information for farmers. Some of the information provided by these images is:

- *Plant counting*: Size of the plant, plot statistics, stands number, compromised plots and planter skips.
- *Height of the plant*: Height and density of the crop.
- *Vegetation indices*: Leaf area, anomaly detection, treatment efficacy, infestations, phonology.
- *Water needs*: Damage/drown out irrigation, property, moisture, erosion (Doddamani, Kouser and Ramya, 2020).

Soil Assessment (Soil and Field Analysis)

- Temperature and moisture
- Water issues and irrigation systems
- Ground erosion and modifications, topography
- Collecting of data for insurance claims (e.g. after storms)

Drone data can also be used to collect soil characteristics such as temperature, humidity, slope, elevation, and more, allowing for more precise soil sampling and more effective seeding prescriptions.

Plant Emergence and Population: Professionals like agronomists are increasingly using data from drones in order to better understand which plants are emerging from their population and spacing metrics. Such knowledge can then guide decisions on replanting, thinning and pruning operations, and improve crop models (Doddamani, Kouser and Ramya, 2020).

Fertility: High-resolution images captured from the drone enable the farmers to assess crop health at different growth stages and allow them to apply the right fertiliser at the right rates at the right time, reduce waste, and optimise crop health and production.

Crop Protection: The results of drone stress assessment and crop growth direct the proper and efficiently optimised implementation of crop protection products that meet each acre's exact needs.

Insurance: On-demand, high-resolution drone data is ideal for recording and reliably documenting incidents that lead to economic loss, such as crop damage, degradation, and reduced safety, offering a comprehensive digital record that can support a more effective change process. Throughout the agricultural insurance and appraisal market, drones are widely used, including for forensics in insurance claims. Drone imagery is very advantageous to provide a precise estimate of the loss. Crops are screened using both visible and near-infrared light, and the tool can detect various pathogens, reflect different amounts of green light and NIR light, and generate multi-spectral images that track plant changes and identify their health (Hassan-Esfahani et. al., 2014).

Irrigation and Drainage: In addition to crop-specific operations, drones are equipped with RGB and thermal infrared cameras that match irrigation system planning and troubleshooting. Drones with hyper-spectral, multi-spectral, or thermal sensors can either recognise dry areas of a field, or suggest improvements if appropriate. Additionally, once the crop is grown, the drones allow calculating the plant index, which determines the relative density and health of the crop, showing the heat signature, the amount of energy or the heat emitted by the crop (Doddamani, Kouser and Ramya, 2020).

Harvest Planning: Data collected at different growing stages of plants is helpful to agronomists and agricultural engineers to improve their models, predictions, and planning, resulting in better anticipation of both harvest quality and yield.

Planting: Nowadays, start-up companies have developed a drone planting system that reduces the uptake rate to 75% and planting costs by 85%. These systems shoot seed pods and plant nutrients into the soil, thus providing the plant with all the minerals needed to sustain life by spraying the crops.

Challenges of Drone Technology in Farm Management

One of the key challenges related to data management is the fact that, along with accuracy and precision of information, the size of datasets grows accordingly, generating up to 140 GB of data for a single square kilometre with a ground sampling distance (GSD) of 1 centimetre. To address this challenge, a data strategy tailored to specific requirements is necessary (Doddamani et al., 2020). Another key challenge is incorporating drone-borne imaging and advanced image data processing and analysing the existing agricultural processes to ensure that the agriculture sector can fully control new information (Hartmann et al., 2012).

Flight Time and Flight Range: There are some problems with drones in agriculture. Most of the drones have a short flight time of between 20 minutes and an hour. This limits the acreage that it can cover for every charge. The flight range also limits the radius that can be covered during every flight time. Drones that can offer longer flight times and a longer range are relatively costlier (Fly Dragon Drone Tech., 2013).

Weather Dependent: According to Doddamani et al., (2020), drone operations are heavily dependent on climatic conditions, thus limiting their usage. Drones are much more prone to climatic conditions than traditional aircraft. If it is very windy or rainy outside, you may not be able to fly them.

Knowledge and Skill: The images require analysis by a skilled and knowledgeable person for them to be translated into any useful information. This means an average farmer without these skills may need training or may be forced to hire a skilled professional conversant with the analysis software to help out with the image processing. According to Fly Dragon Drone Tech (2013), drone technology keeps improving every day. With many manufacturers entering the industry, it is hoped that the cost of the drones and the accompanying equipment will be reduced. Improvements in technology are also expected to solve limitations like flight time and range. These improvements will ensure that farmers reap more from the use of drones.

Connectivity: Most farmlands may not have sufficient connectivity, so either the farmer needs to invest in connectivity or purchase a drone capable of collecting data locally for later processing.

Methodology

Correlational survey design was adopted for the study. The study was conducted in South-South Nigeria. The population of the study consisted of agriculturalists in South-South Nigeria. Stratified sampling technique was used in selecting 30 agriculturalists in each of the states in the South-South Nigeria. This gave a total of 180 sample size used for the study. The instrument used in this study for data collection was a questionnaire titled "Drone Technology for Effective Farm Management and Adequate Food Availability Questionnaire (DTEFMAFAQ)". Face and content validation of the instrument was carried out by an expert in testing, measurement, and evaluation to ensure that the instrument has the accuracy, appropriateness, and completeness for the study under consideration. The reliability coefficient obtained was 0.80, and this was high enough to justify the use of the instrument. The researcher subjected the data generated for this study to appropriate statistical techniques such as percentage analysis. The test for significance was done at 0.05 alpha levels.

Results and Discussion of the Findings

Research Questions

Research Questions 1: The research question sought to find out the impact of drone technology on effective farm management. To answer the research descriptive analysis was performed on the data, (see table 1).

Table 1: Descriptive statistics of the impact of drone technology on effective farm management

Variable	N	Arithmetic mean	Expected mean	R	Remarks
Drone Technology	180	16.07	12.5	0.94	*Strong to Perfect Relationship
Effective Farm Management		17.62	12.5		

Source: Field Survey

The above table 1 presents the result of the descriptive analysis of the impact of drone technology on effective farm management. The two variables were observed to have Strong to Perfect Relationship at 0.94%. The arithmetic mean for drone technology (16.07) was observed to be greater than the expected mean score of 12.5. In addition to that, the arithmetic mean as regards effective farm management (17.62) was observed to be higher than the expected mean score of 12.5. The result therefore means that there is remarkable impact of drone technology on effective farm management.

Research Questions 2: The research question sought to find out the impact of drone technology on adequate food availability. To answer the research descriptive analysis was performed on the data, (see table 2).

Table 2: Descriptive statistics of the impact of drone technology on adequate food availability

Variable	N	Arithmetic mean	Expected mean	R	Remarks
Drone Technology	180	16.07	12.5	0.92	*Strong to Perfect Relationship
Adequate Food Availability		16.57	12.5		

Source: Field Survey

The above table 2 presents the result of the descriptive analysis of the impact of drone technology on adequate food availability. The two variables were observed to have Strong to Perfect Relationship at 0.92%. The arithmetic mean for drone technology (16.07) was observed to be greater than the expected mean score of 12.5. In addition to that, the arithmetic mean as regards adequate food availability (16.57) was observed to be higher than the expected mean score of 12.5. The result therefore means that there is remarkable impact of drone technology on adequate food availability.

Hypothesis

Hypothesis One: The null hypothesis states that there is no significant influence of drone technology on effective farm management. In order to answer the hypothesis, simple regression analysis was performed on the data (see table 3).

TABLE 3: Simple Regression Analysis of the influence of drone technology on effective farm management

Model	R	R-Square	Adjusted R Square	Std. error of the Estimate	R Square Change
1	0.94a	0.88	0.88	0.48	0.88

***Significant at 0.05 level; df= 178; N= 180; critical R-value = 0.197**

The above table 3 shows that the calculated R-value (0.94) was greater than the critical R-value of 0.197 at 0.05 alpha levels with 178 degrees of freedom. The R-Square value of 0.88 predicts 88% of the influence of drone technology on effective farm management. This rate of percentage is highly positive and therefore means that there is significant influence of drone technology on effective farm management. It was also deemed necessary to find out the influence of the variance of each class of independent variable as responded by each respondent (see table 4).

TABLE 4: Analysis of variance of the influence of drone technology on effective farm management

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	287.71	1	287.71	1261.34	.000b
Residual	40.60	178	0.23		
Total	328.31	179			

a. Dependent Variable: Effective Farm Management
b. Predictors: (Constant), Drone Technology

The calculated F-value was (1261.34) and the P-value as (.000b). Being that the P-value (.000b) is below the probability level of 0.05, the result therefore means that there is significant influence exerted by the independent variables i.e. drone technology on the dependent variable which is effective farm management. The result therefore means that there is significant influence of drone technology on effective farm management. The result therefore is in agreement with the research findings of Minhaj, (2022) who stated that the benefits of drones in agriculture are numerous. It is one of the technologies that drive precision agriculture. The significance of the result caused the null hypotheses to be rejected while the alternative was accepted.

Hypothesis Two: The null hypothesis states that there is no significant influence of drone technology on adequate food availability. In order to answer the hypothesis, simple regression analysis was performed on the data (see table 3).

TABLE 5: Simple Regression Analysis of the influence of drone technology on adequate food availability

Model	R	R-Square	Adjusted R Square	Std. error of the Estimate	R Square Change
1	0. 92a	0.84	0.84	0.54	0.84

***Significant at 0.05 level; df= 178; N= 180; critical R-value = 0.197**

The above table 5 shows that the calculated R-value (0.92) was greater than the critical R-value of 0.197 at 0.05 alpha levels with 178 degrees of freedom. The R-Square value of 0.84 predicts 84% of the influence of drone technology on adequate food availability. This rate of percentage is highly positive and therefore means that there is influence of drone technology on adequate food availability. It was also deemed necessary to find out the influence of the variance of each class of independent variable as responded by each respondent (see table 6).

TABLE 6: Analysis of variance of the influence of drone technology on adequate food availability

Model	Sum of Squares	Df	Mean Square	F	Sig.
Regression	273.40	1	273.40	921.64	.000b
Residual	52.80	178	0.30		
Total	326.20	179			

a. Dependent Variable: Adequate Food Availability
b. Predictors: (Constant), Drone Technology

The calculated F-value was (921.64) and the P-value as (.000b). Being that the P-value (.000b) is below the probability level of 0.05, the result therefore means that there is significant influence exerted by the independent variables i.e. drone technology on the dependent variable which is adequate food availability. The result therefore means that there is significant influence of drone technology on adequate food availability. The result therefore is in agreement with the research findings of Doddamani, Kouser and Ramya, (2020) which stated that drone provides a holistic view of a crop's growth, enabling professionals to fast and precisely identify the issues and target their field scouting and also the data gathered from the drones are helpful for facilitating better planning and monitoring improvements like ditches and fertilizer applications. The significance of the result caused the null hypotheses to be rejected while the alternative was accepted.

Conclusion

It is therefore concluded from the study that drones are remotely piloted aircraft systems without a human pilot aboard. The drone used for agricultural activities is known as the "agriculture drone. It is mainly used to assist in crop production and to monitor crop growth. In many areas, drone use has already become an essential part of large-scale precision farming operations. The data collected from drones recording fields helps farmers plan their planting and treatments to achieve the best possible yields. In farm management, making decisions by the farm manager involves the integration of information from the biological, physical, and social sciences. Furthermore, food availability addresses the "supply side" of food security and is determined by food production, stock levels, and net trade. Cover cropping, which is seen as one of the most effective farm management strategies in farmlands, improves soil fertility and soil quality, prevents soil erosion as well as prevents nitrogen leaching or runoff while improving the quality of water and sustaining microbial biodiversity in the soils.

Drone technology has many prospects in farm management, ranging from the advantages of time saving, easy spraying of fertilisers and pesticides, to improving crop yields and giving adequate data for farm analysis. Drone technology has impacted food availability with some of the roles it plays in the farming sector. The drone technology helps with irrigation, spraying of fertilizers, pesticides and herbicides. It also served security reasons for crops and livestock. With all the impact and prospects of the drone in the farming sector, it is seen to have some challenges and limitations which affect its operation. Some of these include the fact that the drone's operation in the farm is dependent on weather conditions; another is the time of flight of the drone.

Recommendations

It is therefore recommended from the study that

1. The use of drones should be implemented in farm management activities to increase crop yields and food availability for the masses.
2. Drone software should always be updated to improve its efficiency and accuracy while in use by agricultural drone operators. Some drone batteries also need software updates for better efficiency.
3. Adequate training must be given to proposed drone operators on how to operate the drone, the rules and regulations governing the use of drones, the care and maintenance of the drone technology and types of drones and their uses, respectively. This will prolong the lifespan of the drone technology in use.

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