



Sustainability Of Digital Innovation In Agricultural Management: The Case Of Poultry Farmers In North Central Nigeria.

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Abstract

This study examines how farmers in North Central Nigeria are utilizing digital technology to manage their poultry farms, the proportion of farm operations that are currently managed digitally, the main advantages that farmers see from using digital innovation in poultry management, the significance of ensuring sustainability in the implementation of digital innovation in the management of poultry farms in North Central Nigeria, and government policies and initiatives that support the sustainability of digital agricultural innovation in North Central, Nigeria. Using a simple sample technique based on availability and proximity to the study site, 101 chicken producers from Benue, Plateau, Kwara, Kogi, Nasarawa, Niger, and the Federal Capital Territory Abuja participated in the descriptive study. Data were collected using closed-ended questionnaires; the internal consistency of the questionnaire was confirmed by the Cronbach Alpha reliability coefficient (r-coefficient of.86) and the Content Validity Ratio (CVR of.099) obtained from the Lawshe's formula, which also confirmed the appropriateness and clarity of the questionnaire items. On-the-spot data collection, organization, and analysis were done with percentages and frequency counts. The results indicate that, with a focus on poultry farmers in the area, government policies and activities aimed at ensuring the sustainability of digital innovation in agricultural management are not well known or utilized by poultry farmers in the region. It is important to prioritize digital security and e-commerce in order to increase productivity and farmers' confidence in implementing new technologies in favor of outdated ones.

Keywords: Sustainability, Digital Innovations, Agricultural Management, Poultry Farming

Introduction

The agricultural sector in developing and less developed nations provides employment and a means of subsistence for most of the population, is a significant source of foreign exchange earnings, supplies raw materials to local industry, and holds significant potential for the economic development of those nations. Despite this, the sector has not been able to guarantee food security for households and national levels, support other sectors, or accelerate socio-economic development due to factors such as the use of agricultural technologies and practices that have been passed down from generation to generation with little to no

improvement, storage and transportation issues, and structural issues (Dethier & Effenberger, 2012). To address these issues, a significant amount of sustainable agricultural innovation is needed. Since the market is not limited to North Central Nigeria, there are a number of obstacles that need to be overcome in order to improve both the nutrition condition of Nigerians and the production of poultry in that region (World Economic Forum, 2023). To support the poultry industry's future expansion throughout the region, for instance, measures to improve the birds' immunity, health, and productivity should be taken. In addition, it is imperative to sufficiently handle consumer confidence, product quality and safety, product types, and immunizations and medications for chicken diseases in order to bolster the poultry industry's economic sustainability.

To address these difficulties relating to poultry, African nations should increase their technological competence and innovative capabilities, according to the African Union High-Level Panel on Emerging Technologies (APET). This has the potential to significantly increase Africa's chicken production capability. According to APET, processes for producing chickens should be modified to improve resource efficiency and energy use. Technological innovation and low-carbon technology can help achieve this. Nevertheless, this progress will continue to support the growth of infrastructure for the completely chicken value chain, breeding, hatching, production, processing, and consumption. Automated water dispensers, robotics, and automated feeders are a few examples of the cutting-edge techniques and technologies that APET urges poultry farmers to use in order to improve poultry farming in Africa. Robots can be used to remove chicken bones from flesh during the manufacturing process, which will speed up the process. Furthermore, automating some of the basic procedures for growing hens, such as managing litter, giving vaccinations, and assessing the health of the birds, can boost output and free up staff members to concentrate on processing and making decisions (Iwuoha, 2024). Using technologies like remote sensing, data may be collected to monitor chicken uniformity and quantify weight, enabling precision poultry production (AUDA-NEPAD, 2022). Therefore, data collecting makes it simple for farmers to automate and streamline the production of poultry. To improve interactive monitoring tools for flock health and behavior, farmers can gather audio and video information. They can also use image recognition software and robot "nannies" in this way. This can supplement linked feed programs to help farmers figure out the most economical, nutrient-dense chicken diets (Global Ag Media, 2000-2024) and create digital products for the chicken industry.

Machine learning, a subset of artificial intelligence, can improve data processing and collecting to facilitate decision-making with little to no human involvement. Photo, video, and audio data may all be integrated with machine learning to create new solutions for poultry operations. One digital technology that facilitates science-based animal husbandry techniques and, as a result, improves the wellbeing of chickens raised in animal farms is the Chick Track model (Suresh Neethirajan, 2022). Additionally, machine vision, a component of artificial intelligence, can be used to evaluate eggs and detect defects such as internal blood spots and breaking. Farmers can assess an egg's fertility or sterility during incubation by scanning the egg. For example, the method predicts fertility with over 98% accuracy by day five of incubation (Dembow, 2018). It is possible to modernize chicken agriculture by utilizing innovative marketing strategies, food, healthcare, and flock breeds. By implementing

rearing technologies, such as low-cost, semi-automated local hatcheries for hatching chicks for one to 21 days, this can enhance meat and layer breeds (Food and Agriculture Organization, 2024) This can lower mortality and improve delivery. In addition, full-time confinement in chicken houses can provide illumination, a steady supply of water, and effective feed usage. Increased production can improve cheap feeds at various phases of meat and egg production, as feeds make up a larger portion of poultry raising (Technologies for African Agricultural Transformation (TAAT) Programme, 2022).

Vaccinating chickens against diseases like Newcastle viruses and enhancing their health with preventive antibiotics are other ways to improve poultry health. Therefore, as poultry may pose a threat to human biosecurity in the region, greater access to veterinary services should be given priority. By using digital technologies, poultry farmers can obtain these veterinary services more quickly and effectively. Mechanized de-feathering, dependable egg grading, staggered production batches, and industrial-standard poultry killing are other important aspects of industrialized poultry production. Therefore, larger-scale producers ought to provide poultry parts in addition to the first stage of processing the entire bird (Dugbazah et al., 2022). According to (Dugbazah et al., 2022), small-scale poultry farming businesses should be arranged into production and marketing centers in order to gain access to more markets. This has the potential to significantly increase manufacturing volume and boost group sales. Digitalization of this poultry industry is another way to promote youth-led entrepreneurship in Africa. Poultry dung can also be processed into nutrient-rich, commercially available organic fertilizer. Processing this resource can reduce the amount of gas lost to the atmosphere.

APET concludes by pointing out that not many technologies are specifically designed for chicken farming. This efficiently scales up the poultry business and impedes the advancement of poultry farming. Thus, African nations including North Central Nigeria may effectively manage poultry farming and related businesses with the use of digital innovations. Production efficiency can be increased to satisfy the needs of the African continent and the demand for chicken meat and eggs in the continent. However, via significant expenditures, laws, and regulations, African nations should improve the favorable conditions for agricultural innovation and technologies. Africa may be able to achieve food security and nutrition as a result. Organic and free-range farming, which put animal welfare first, limit the use of antibiotics, and encourage bird access to the outdoors, are examples of sustainable practices in poultry farming. Waste Management and Environmental Sustainability through creative solutions like turning poultry litter into biogas or organic fertilizers, which reduce pollution and create additional revenue streams for farmers, and the use of other data-driven resources to ensure sustainability for greater productivity, they also cater to niche markets willing to pay a premium for ethically produced poultry. A preliminary survey conducted at a few poultry farms in the research area revealed that most farmers are not making use of the new technology to increase productivity, which may be due to various obstacles to their sustainable use. Against this backdrop, this study

Research Questions

1. How familiar are farmers with the use of digital technology in managing their poultry farm?
2. What percentage of farm operations are currently managed using digital tools and resources?
3. What are the major benefits of using digital innovation in poultry management?
4. How important is the sustainability of the implementation of digital innovation in the management of Poultry farms in North Central Nigeria?
5. Are there government policies or initiatives that support the sustainability of digital agricultural innovation in North Central, Nigeria?

Literature Review

The agri-food industry as a whole and agricultural production are undergoing a digital revolution due to the exponential growth in the quantity and scope of digital technology used (MacPherson et al., 2022). According to Wolfert et al. (2017), digital advances have the potential to be broadly applied in all areas of agricultural production, including greenhouses, horticulture, animal production, and arable systems. Spati, Huber, and Finger (2021) claim that the creation and application of digital diagnostic tools have expanded quickly, enabling the collection of data and the usage of monitoring systems using sensing techniques over a range of temporal and spatial scales. These sensors might be anything from portable gadgets to tractors equipped with sensors and scanners to remote sensing systems based on drones and satellite images. Thus, information gathered using digital diagnostic instruments could range from the level of a single leaf, a plant and parts of fields to entire landscapes (Mulla, 2013). Digital innovation resources according to Anderegg et al. (2023); Sa et al. (2018) give a wide range of production-relevant data, for example, on vegetation, crop biomass, nitrogen nutrition status, soil moisture and weed occurrence. Animal production systems can benefit greatly from digital developments as well. Farmers may monitor in real time the health, welfare, and production aspects of their animals thanks to sensors and equipment (Dos Reis et al., 2021; Zhang et al., 2021; Lovarelli, Bacenetti, and Guarino, 2020). Additionally, digital advances are revolutionizing the measurement of agricultural performance by monitoring yield-using sensors at harvesters, which enables highly localized performance measurement with respect to harvest amount and quality (Fulton et al., 2018).

Although there are many potential advantages associated with digital advances, there are also a number of problems in the social, economic, and environmental domains that need to be addressed (Carmela Annosi et al., 2020; Weersink et al., 2018). Energy intensity and associated carbon footprint may rise as agro-food systems become more digitally integrated (García-Martín et al., 2019). Furthermore, farmers continue to be skeptical about how and to what degree digitalization will live up to the hype (Klerkx & Rose, 2020). There is still technological risk and uncertainty since certain breakthrough technologies are still in their infancy and because it is difficult to predict with certainty how production, earnings, and environmental performance will pan out in different scenarios (Finger et al., 2019; Jakku et al., 2019; Stachowicz & Umstatter, 2021). In keeping with this,

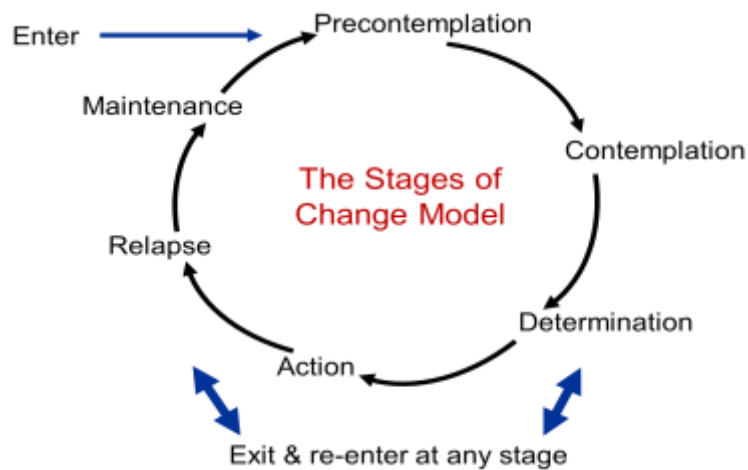
a few highly promising inventions in the automatization and autonomous fields are still in the prototype stages. Farmers continue to view perceived unreliability as a significant barrier to adoption (Spati et al., 2022). Furthermore, farmers are not well versed in the consequences of widespread technology adoption, including possible feedback and rebound processes at markets and in farmers' decision-making. For instance, attempts to reduce the production intensity in environmentally significant areas may be offset by rising farming productivity and profitability because of digital innovation.

The establishment of an enabling environment that offers a broad gradient from technological infrastructure and regulatory frameworks to education and information is a fundamental component of public support for digital innovation (Finger et al., 2019). One way to provide such infrastructure assistance is by implementing new network technologies and telecommunication infrastructure to enable high-speed internet access (FAO, 2022). Furthermore, governments can help farmers and other upstream and downstream stakeholders by supporting and granting access to satellite imagery and data that can be used for high-precision georeferencing applications, adjusting input use decisions, and insurance purposes (Riecken & Kurtenbach, 2017; Vroege, Vrieling and Finger, 2021b). Due to insufficient legal and regulatory frameworks, several digital innovations with significant promise for sustainability and resilience are now limited in their application (Lowenberg-DeBoer et al., 2022). According to Bahlo et al., 2019; Kamilaris, Kartakoullis & Prenafeta-Boldú, 2017 & Lokers et al., 2016), proactive frameworks that facilitate the effective use of digital innovations in the areas of data handling and use, autonomous machinery, and unmanned aerial vehicles can therefore offer policy action points that are both affordable and effective. Addressing underlying data-related challenges and achieving shared ontologies and semantics as well as open and interoperable standards for data management and interchange constitutes another area of policy concern.

Trans-Theoretical Model (TTM)

Prochaska and DiClemente created the trans-theoretical model (TTM) that LaMorte (LaMorte, 2019) cited in order to examine how people's behaviors evolve over time. It is predicated on a person's capacity for decision-making that demonstrates a process of change depending on the person's intentions. The fundamental tenet of TTM is that behavior changes are not going to happen suddenly and permanently. However, these behavioral shifts will happen in a cyclical way. This is claimed to apply especially to ingrained habits.

Figure 1: Trans-Theoretical Model



Source: LaMorte (2019)

Each person will go through six stages of change, according to this model: precontemplation, contemplation, preparation, action, maintenance of action, and termination of the entire habit. Termination was not included in the first model that was devised, and it is used less frequently now. Numerous interventions are utilized to help the person go through these six stages. These therapies could differ depending on the stage. These many approaches will guarantee that the person moves toward the intended stage of behavioral change, known as "maintenance" (LaMorte, 2019; Liu et al., 2018). Based on the implications that digital innovations in agricultural management are evolving in developing nations, particularly in Nigeria, the study is grounded in the Transtheoretical model. To enable satisfactory acceptance, farmers' adaptability must go through a series of transitional phases. Farmers can simplify operations and boost productivity by implementing digital technologies for farm operations, particularly in poultry farming, after the traditional methods of operation are gone. When digital breakthroughs increase productivity, broaden their market reach, and boost farmers' economic standing in the face of adversity, then sustainability is assured.

Methodology

Study Area

North Central Nigeria is roughly located between latitudes 7°, 10°N, and longitudes 3° 14°E (Aper, 2006). Figure 1 shows the six states that comprise the region: Benue, Kwara, Niger, Plateau, Nasarawa, Kogi, and Abuja. Two separate relief regions make up the lower Benue basin. A network of drainage systems in the region forms tributaries that flow from the Benue and Niger rivers. The confluence of the Rivers Niger and Benue occurs at Lokoja. The Benue River's extension drains a larger portion of the area. The climates of Nigeria's northern and southern regions mostly affect the North Central area. The research region is located in the Guinea Savannah ecological belt, which is made up of grasses and shrubs with deciduous trees (Oladipo, 1993).

Figure 1: Map of North Central Nigeria

Source: Ideki & Weli, (2015)

A sandy surface horizon covering a weakly organized clay deposit is typically indicative of the soil. The Precambrian basement complex and the sedimentary formation are the two main geological formations that support the lower Benue basin's geology (Aper, 2006). The focal point of political and administrative activity in the area is the Federal Capital Territory (FCT), which was established in 1976. The lower Benue basin's economy is based primarily on agriculture, with over 70% of the working population employed in farming, fishing, raising cattle, and raising poultry, making the area the nation's food basket.

Sources of Data

Data are facts or numbers that permit deduction. Prior to information being displayed and comprehended, data must be gathered and organized. Data can also be viewed as the raw material from which information is extracted, much as paper is made from trees (Ajayi, 2016). Data collection is a crucial step in statistical analysis. Primary data and secondary data are two categories into which different approaches to data collection for research can be categorized (Douglas, 2015). The two sources that were employed to gather the data for this inquiry were the primary and secondary sources. The primary data source that served as the foundation for the conclusions was a closed-ended survey. Books, electronic articles, unpublished theses, government survey papers, printed journals, and online publishing of scholarly journals were examples of secondary materials that helped to support the study background and literature as well as the collaboration of findings.

Method and Procedure

The research methodology employed in the study was descriptive, meaning that participants' behavior was observed and described without any form of intervention (Martyn, 2008). Descriptive study aims to accurately and systematically describe a population, situation, or phenomenon. Questions regarding what, where, when, and how can be answered by it; however, why cannot (McCombes, 2023). Because the approach allows for a broader diversity of respondent responses, the study uses this design to explore one or more variables using a

wide range of methods and to evaluate the sustainability of the digital innovations in boosting agricultural management. 101 poultry farmers from seven local government areas in the six north central states including the federal capital territory whose primary occupation is food production were included in the study. These samples were chosen using a convenient sampling technique that took into account the farmers geographic proximity and only included those who were available during the investigation. A 20-item, closed-ended questionnaire was employed as a data collection tool to capture the sustainability of the digital innovations in poultry farm operations and management in North Central Nigeria.

In order to establish content validity, the survey tool was validated using the Lawshes template. A threshold of 0.99 was recorded, indicating that the questionnaire was representative and clear. Using the Cronbach alpha method, a reliability coefficient alpha of 0.82 was observed, confirming the instruments homogeneity. After the researcher and the participants interacted, the data was immediately gathered with the assistance of an interpreter to help with language barriers and to make the idea being studied easier for the less educated participants to understand. The data collected via the questionnaire were described using frequency counts (f) and percentages (%).

Results and Discussion

Familiarization and Application of Digital Innovations in Agricultural Management

The study looked into how familiar digital technologies are with increasing the efficiency of poultry farming in order to ensure the sustainability of these advances in agricultural management among poultry farmers in North Central Nigeria. The outcome is displayed as follows.

Figure 1: Response Distribution

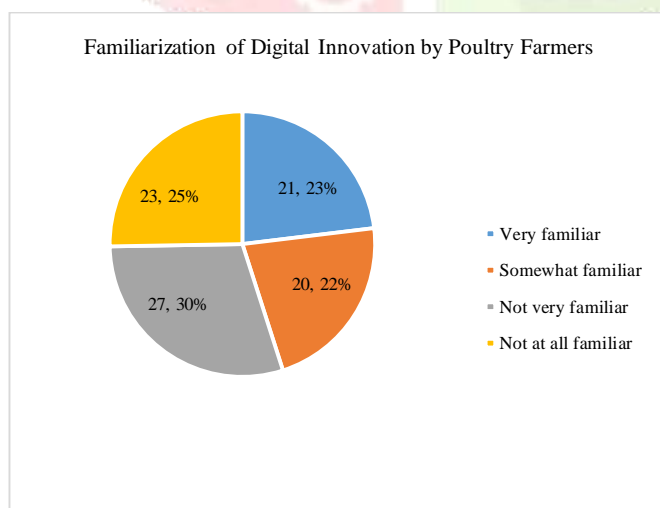
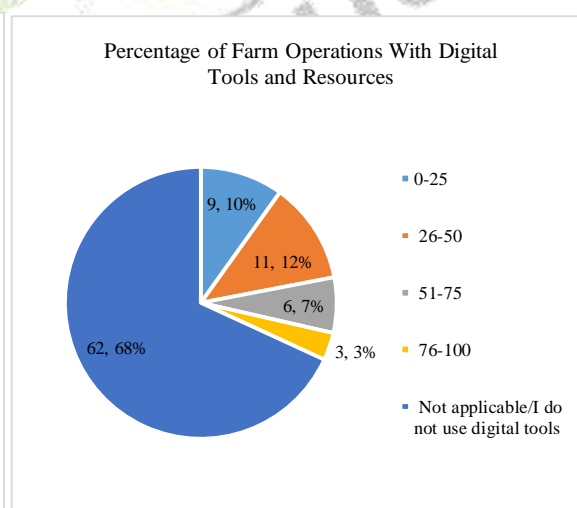


Figure 2: Response Distribution



Compared to 20(22%) who are only vaguely aware of the use of digital innovation for increased poultry productivity, 21(23%) of poultry farmers are familiar with the use of digital technology for efficiency in poultry farming. However, a large number of farmers 27(30%) do not have much experience using digital technology for managing and operating poultry farms, and another 25 percent do not know about digital advancements in

agricultural management that can increase the productivity of poultry production. To affirmed the level of application of digital technology by poultry farmers in figure 2, 9(10%) farmers only apply digital technology to 0-25% in their operations, 11(12%) apply 26-50% to their farm operations, only 6(7%) affirmed applying digital technology to 51-75% of their operations while, 62(68%) confirmed the construct does not apply to them because they do not use digital tools in their poultry farms. The region's familiarization, uptake, and utilization of digital advances are lacking. It is thought that depending on where in the region a chicken farm is located, different states will accept and employ digital advances differently. Urban farmers and farmers raised in urban areas have demonstrated a fair degree of familiarization, adoption, and use of digital innovations, particularly when it comes to high productivity. However, these farmers' farms are located in rural areas where access to digital services and alternative energy measures are necessary. According to Bolfe et al. (2020), encouraging rural farmers to adopt and employ digital innovations for sustainable agricultural practices can be achieved through Common Agricultural Policy like in the case of the European Union, in order to give rural farmers in North Central Nigeria access to digital infrastructure that would support the adoption and use of innovations to ensure sustainable growth in the region.

The adoption and use of digital agricultural technologies is growing quickly, with China being a leading nation in this field. In certain areas of Benue, Plateau, and Niger states, a small number of farmers have been early adopters of digital practices and have been investing in research and development for sustainable utilization in booting agricultural practices similar to those in Asia. To boost poultry farm operations and lessen the impact on the environment, the government has been encouraging the use of digital agricultural technologies (Addis, et al. 2021).

Compared to other African regions, North Central Nigeria still has a poor adoption and use rate for digital advances in agricultural management. This is because of a number of issues, including low levels of investment in research and development and restricted access to infrastructure and technology. Nonetheless, there are programs designed to encourage the application of digital innovations in Africa, such as the Digital Agriculture Services project of the African Agricultural Technology Foundation, which farmers in North Central Nigeria are expected to utilize to increase productivity and efficiency (Taoufik, 2020). In general, the region's states differ on how they adopt and apply digital innovations in agricultural management. A number of factors, including infrastructure and technology accessibility, governmental policies and programs, and funding for research and development that is backed by the findings of Raimi & Panait (2021) causes these variations. Degila 2023's findings revealed a rise in agro-digital projects throughout the five nations, which were categorized into seven groups according to their goals. A steady increase in the use of mobile internet was also seen, in spite of variations in the implementation of essential infrastructure for digital agriculture. In all five of the countries, the mobile connection index (MCI) is less than 60. However, particularly in rural regions, Ghana and Côte d'Ivoire showed more efforts in providing access to electricity and the internet. While the other nations are attempting to build one or include it into their national development plans, Benin and Nigeria have produced

distinct documents outlining the path for digital agriculture. Regarding the laws and procedures safeguarding agro-digital innovation, several countries have similarities and differences.

Major Benefits Digital Innovation in Poultry Farm Management

Table 2: Response Distribution

Benefits	Agreed		Not Sure		Disagreed	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Increased efficiency and productivity in farm operations	32	35.16	46	50.55	13	14.29
Improved decision-making through data-driven insights	28	30.77	57	62.64	6	6.59
Cost reduction in terms of labor, inputs, and maintenance	23	25.27	49	53.85	19	20.88
Access to real-time market information for better market planning	31	34.07	43	47.25	17	18.68
Enhanced traceability and transparency in supply chain management	30	32.97	51	56.04	10	10.99
Reduced risks and losses through early detection and prevention of diseases	34	37.36	50	54.95	7	7.69
Improved animal welfare through remote monitoring and control	36	39.56	47	51.65	8	8.79
Easy record keeping and compliance with regulations	29	31.87	53	58.24	9	9.89
Increased access to financial services and credit opportunities	33	36.26	45	49.45	13	14.29
Potential for higher profits and income for farmers	35	38.46	51	56.04	5	5.49

Source: Field Study, 2024

A significant proportion of poultry farmers 32(35.16%) agreed that increased efficiency and productivity in farm operations is one of the major benefits of digital innovations in poultry farming. Majority 46(50.55%) are not sure if digital innovation can improve efficiency and productivity while 13(14.29%) disagreed and did not see digital innovations as a facilitator towards improved productivity and efficiency. Improved decision-making through data-driven insights was identified by 28(30.77%) farmers as a major benefit of digital innovations in agricultural management; however, the majority of the farmers (62.64%) are not sure if digital innovations can improve decision-making through data-driven insights while, 6(6.56%) farmers did not see improve decision-making through data-driven insight as a benefit farmers can derive from digital innovation. However, cost reduction in terms of labor, inputs, and maintenance was agreed by 23 (25.27%) farmers as a major benefit of digital innovation to poultry farmers unfortunately, 49(53.85%) were not sure while, 19 (20.88%) did not agree digital innovation can reduce cost of labor, inputs and maintenance of poultry farms in North Central Nigeria. An impressive proportion of farmers 31(34.0%) believes digital innovation provides access to real-time market information for better market planning although, 43 (47.25%) were undecided while 17(18.68%) were in disagreement that the digital economy is capable of enabling farmers to access real-time market information for better market planning. Furthermore, 30(32.97%) agreed that digital innovations enhanced traceability and

transparency in supply chain management however majority of the farmers 51(56.04%) were undecided while, very few of them 10(10.99%) disagreed that digital innovation promote traceability and transparency in supply chain management.

Reduced risks and losses through early detection and prevention of diseases was identified by 34(37.36%) farmers as a great benefit enjoyed from the use of digital innovation although majority 50(54.95%) were uncertain while, few of them 7(7.69%) disagreed that early detection and disease prevention is a function of digital innovation in agricultural management. Similarly, 36(39.56%) farmers agreed that the new technologies in the management of poultry farm operations helps farmers to improve animal welfare through remote monitoring and control however majority 47(51.65%) of the farmers were not sure while only 8(8.79%) disagreed. Easy record keeping and compliance with regulations was identified by 29(31.87%) as a major benefit of digital innovation in improving efficiency in poultry farms operations although majority of the farmers 53(58.24%) were undecided while 9(9.89%) disagreed. In addition, 33(36.26%) farmers agreed that digital innovation in the management of poultry farm operations increased access to financial services and credit opportunities; however, 45(49.45%) were not sure while 13(14.29%) disagreed. Potentials for higher profits and income for farmers was identified by 35(38.46%) farmers to be a major benefit of digital innovations in poultry farming although, many farmers 51(56.04%) were undecided while very few 5 (5.49%) disagreed. The region's farmers have an astounding understanding of the main advantages for the uptake and sustainability of digital advances in the administration and operations of poultry farms, particularly in the field of precision animal farming: Three distinct tasks are usually involved in implementing new sensors and technology to improve chicken production: monitoring and sensing, analysis and decision-making, and intervention (Wolfert et al., 2017).

Accuracy by eliminating the need for manual observations and human decision-making, livestock farming systems enable the automation of these processes. They also significantly reduce the time and effort required to manage large numbers of animals and enable real-time monitoring and management of the animals on the farm. According to Jake et al. (2020), infections that affect poultry can be extremely dangerous to the health of both humans and animals. However, with the use of digital technology for quick diagnosis and detection of infectious diseases, intelligent poultry management techniques can reduce the risk of infection and sickness. The ability to conduct a medical diagnostic test in a location where a patient can receive care, as opposed to a laboratory, is known as point of care diagnostics. Speedier detection and diagnosis can result in speedier treatment, which makes this perfect for poultry farms. Many data will be produced as more sensors and technology are used in chicken raising operations. Poultry businesses will face difficulties in gathering, analyzing, and using all of this data (Banhazi, 2009). To be understood and used by producers, these data will need to be electronically processed and stored. To fully utilize the data produced by newly integrated technologies, mechanisms for data collection, storage, and access need to be put in place. The application of digital innovations in precision livestock farming has already advanced practices in the poultry industry in a number of areas, including automated systems for weighing birds and calculating feed and water consumption, as well as technologies for

imaging poultry barns to analyze bird behavior. As long as these technologies are developed, farmers will be able to grow more birds and expand their poultry production systems, which will enhance production levels (Jake 2020).

Importance of Sustainability in the implementation of Digital Innovations in Agricultural management

Table 2: Response Distribution

Items	Agreed		Not Sure		Disagreed	
	Freq.	Percent	Freq.	Percent	Freq.	Percent
Extremely important in ensuring long-term success	63	69.23	21	23.08	7	7.69
Crucial for efficiency and productivity	62	68.13	18	19.78	11	12.09
Essential for sustainable growth in the industry	67	73.63	14	15.38	10	10.99
A key factor for sustainable agricultural practices	66	72.53	13	14.29	12	13.19
Critical for the future of agriculture in Nigeria	69	75.82	15	16.48	7	7.69
Imperative for environmental and economic sustainability	64	70.33	17	18.68	10	10.99
Fundamental for ensuring continued profitability	68	74.73	15	16.48	8	8.79
Vital for the success of digital innovation in agriculture	71	78.02	13	14.29	7	7.69
Indispensable for improving food security and stability	73	80.22	11	12.09	7	7.69
Necessary for ensuring a sustainable future for farmers and their communities	69	75.82	14	15.38	8	8.79

Source: Survey Data 2024

According to the results, 64 farmers, or 69.23%, agreed that digital innovation is crucial for assuring long-term success in agriculture. However, 21 farmers, or 23.08%, expressed uncertainty, and a small percentage of farmers, or 7.69%, disagreed and thought digital innovation was not vital for assuring sustainability in agriculture. Additionally, 62 farmers (68.13%) stated that digital innovations are essential for production and efficiency, while only 18 farmers (19.78%) were unsure and 11 farmers (12.09%) did not agree with the majority of farmers. The majority of farmers, 67 (73.53%), believed that digital innovation was necessary for the agricultural sector to thrive sustainably. However, 10 (10.99%) disagreed and 14 (15.38%) were unsure. Nonetheless, 66 farmers (72.53%) agreed that digital innovations are essential for sustainable agriculture operations, 13 farmers (14.29%) were unsure and 12 farmers (13.19%) disagreed.

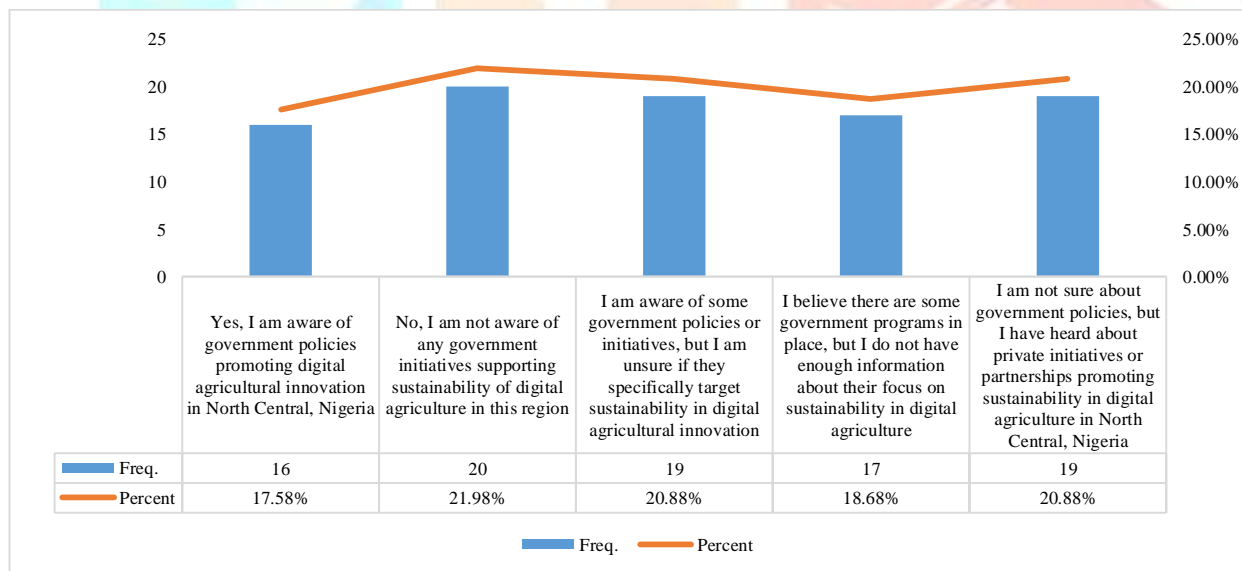
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while 11 (12.09%) were unsure. 69 farmers, or 75.82 percent, said that digital innovations are essential to ensuring a sustainable future for farmers and their communities. However, 14 farmers, or 15.38 percent, were unsure, and 8 farmers, or 8.79 percent, disagreed. Digital technologies have the potential to be widely used in all fields of agricultural production, e.g. ranging from arable systems and livestock production to horticultural production and greenhouses (e.g. Wolfert et al., 2017).

Digital innovations can increase the efficiency of poultry farming systems. For example, guidance systems and controlled traffic farming allow the avoidance of overlapping operations and thus reduce input use and fuel consumption without affecting production levels (Gasso et al., 2013). Along these lines, adopting precision livestock farming for instance, adjusted feeding, veterinary practices can improve environmental, and poultry welfare outcomes while maintaining productivity (Berckmans, 2014; Scholten et al., 2013). Digitalization can also enable farmers to substitute harmful practices with less harmful approaches by enabling efficiency and substitution, which benefit the chicken welfare, which will benefits in savings cost and avoiding hazardous working conditions aimed at reducing food production or the provision of other ecosystem services.

Government Policies or Initiatives that Support the Sustainability of Digital Agricultural Innovation in North Central, Nigeria

Figure 3: Response Distribution



When asked, 16 (or 18%) of the farmers in North Central Nigeria confirmed that they are aware of government programs and policies that support the sustainability of digital innovations in agricultural management. However, 20 (or 22%) of the farmers responded negatively and stated they are unaware of any such programs or policies. Nonetheless, 19(21%) people are aware of government initiatives aimed at promoting sustainable digital agriculture, although they are unsure if these initiatives particularly address sustainability in digital agricultural technologies. While 19(21%) farmers are unaware of government policies but are aware of private initiatives or partnerships promoting sustainability in digital agriculture in North Central Nigeria, 17(19%) farmers believe that some government programs are in place, but they do not know enough about their focus on sustainability in the industry.

Using e-policies and e-strategies on e-content, e-trust, e-security, e-value addition, and end-user-driven e-technologies can lead to the sustainable and inclusive development of digital innovation in agricultural management (Maumbe, 2010). In order to support states in developing their e-agriculture strategic plans, awareness and regional harmonization are needed. This can be achieved by encouraging integration and sharing of experiences among poultry farmers in North Central Nigeria, and by analyzing the policies and strategies currently in place for these farmers. The majority of states continue to struggle to establish an atmosphere that is conducive to business (FAO, 2022). However, the majority of the states in the area had created an e-agriculture strategy. Therefore, it is essential to carry out the plan and keep an eye on the success indicators while keeping an open window for ongoing improvements to the regulatory framework and enabling policies. Both public and private actors are actively involved in fostering creative solutions through various start-ups, platforms, projects, and programs in all of the states in the region that have been investigated. The majority of farmers are unaware of the numerous programs that have made it simple for farmers to access markets that link them with consumers and agricultural inputs. Despite the obstacles posed by the legal, political, social, and economic spheres, these mobilizations that differ among the states are developing. According to Coggins et al. (2022), ignorance, inaccessible mobile networks, inaccessible electricity, inaccessible devices, slow access, unfamiliar language, insensitivity to digital illiteracy, insensitivity to user knowledge, insensitivity to priorities, insensitivity to socioeconomic constraints, and irrelevance to farms are the most common barriers to full digital extension technology. The sustainable growth and adoption of digital agriculture is still hampered by elements like the high rate of illiteracy and ignorance of digital technology among poultry farmers in North Central Nigeria. Even if the technologies are created, it could be difficult to modify them so that farms work better. Effective policies and coordinated efforts across several development sectors may address this by supporting education and literacy as vital enabling variables, particularly digital literacy among young people who are essential change agents in the field of digital agriculture.

Conclusion

Farmers' awareness of the advantages of digital innovations in poultry management will increase as a result of market information and e-commerce, digital agricultural advisory and management services, connections between actors in the value chain, development of critical enabling factors, weather and climate information, capacity building and training, and the supply of agricultural inputs. These initiatives will also improve sustainability and accelerate economic growth. Therefore, by offering digital infrastructures, policies, and initiatives concerning sustainable adoption, practice, and economic growth, which suggest more sustained commitments to strengthen the sectors' governance, the federal and state governments should work to ensure the development of an enabling environment for digital agriculture. By promoting integration and experience sharing between states, regional harmonization is also necessary to expedite the formation of regional digital innovation in agricultural management policies and plans.

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