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Smart Agri-preneurship Dimensions and Farm Productivity

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Abstract

Smart agri-preneurship is instigating and shaping the scope and depth of farming in crops and animals rearing. This evolves from huge scientific advancement, implementation of various agribusiness tools, and infusion of technologies for the betterment of farm productivity. This paper probes the effect of smart agri-preneurship dimensions on farm productivity in South-West, Nigeria. Cross sectional survey research design was adopted and 558 agri-preneurs were sampled. A structured questionnaire was adapted and used after its validity and reliability were established. The research instrument was self-administered. The analysis revealed that the dimensions of smart agri-preneurship significantly affected farm productivity (Adj. R^2 = 0.671, F(6,551), 190.42, p = 0.000). The nature, level, and direction of individual relative effect differ across the constructs. The study recommends continuous deployment of advanced smart technologies that ensures high farm productivity.

Keywords: Smart Agri-Preneurship, Farm Productivity, Greenhouse Farming, Hydroponics, Nutrient Cycling and Soil Analysis.

Introduction

Farm productivity output around the world has been a major quest, as poverty and hunger enthrall millions and the best-fit model to alleviate starvation seems elusive. The nature and depth of food insecurity have generated multidimensional approaches to hunger, food sourcing and opportunities for entrepreneurs. This is perceived to be arising from the continuous growth in population and traditional farming methods, which produce low nutritious food output and divorce of technology. For many people, efforts to secure food have dictated everyday activities of work, hunting, gathering, and farming, ranching and fishing in developing economies. The outlook is more of survival in the short and long-term, rather than the pursuit of grand ideas. This seems to stem from farm productivity challenges, with low entrepreneurial investment in agribusiness, erratic and volatile business environments that make long term investment insecure.

In scrutinizing farm productivity output in a sponsored research by the Bill and Melinda Gates Foundation (BMGF), it was discovered that more than 40% of extremely poor people in the world will be living in Nigeria and Democratic Republic of Congo by 2050 (Gates, 2019). The current estimate of 86.9million out of over 170million people are already food insecure in Nigeria and only 30 million hectares of farmland is under cultivation annually, short of the estimated 78.5 million needed for nutritious food production (Food and Agriculture Organization [FAO], 2018). The need to increase productivity of more nutritious food is pressing and smart agri-preneurship is a key to address growing food insecurity (Achim, Robert, Robert & Nina, 2017). The challenges of low farm yield, low food affordability, low food accessibility, and low farm productivity are impediments to the attainment of food security output as economies expand and population growth rises (Rajaram & Ginkel, 2019).

The paradigm shift in developing economies from reliance on aids and donations, to tackling farm productivity, has led to indigenous solutions propelled by knowledge and technology share (Ashe, 2019). The rise in greenhouse farming, geo-mapping, hydroponics, soil analysis, nutrient cycling, and the varied dimension of smart agri-preneurship to address farm productivity is a step in the right direction (Ariani, Hervani & Setyanto, 2018). The broader involvement of agribusiness sector and integration of technologies or smart practices is to stimulate increase in the farm productivity of farmers and compliment the efforts of smart agri-preneurs. The presumption is to reduce food insecurity through engagements that yield upfront off-take agreements, technology usage, climate awareness, wastage reduction initiatives and value chain inclusiveness by smart agri-preneurs.

There are embryonic indications that agribusiness in the last 10years had impact on the Gross Domestic Product [GDP] in Nigeria. The country had an increase of 3,857,705.59 NGN Million in the second quarter of 2019 from 3,597,916.08 NGN Million in the first quarter of 2019 and an averaged 3,833,624.00 NGN Million from 2010 until 2019 (Adelowokan, Maku, Babasanya & Adesoye, 2019). With this report (Adelowokan et al., 2019), extreme hunger and poverty will remain prevalent until the critical issue of productivity is addressed in Nigeria (Gates, 2019). Suggestive reasons why there has not been an average decline in the contribution of agribusiness to National GDP, is due to shift from traditional agriculture to agribusiness and most recently smart agri-preneurship at private sector levels, which tend to evolve from widespread subsistence agribusiness, attempting to address farm output (Fouilleux, Bricas & Alpha, 2017).

Smart agripreneurial dimensions such as greenhouse farming, hydroponics, geo-mapping, drone agriculture, soil analysis and nutrient cycling are productive larger-scale that add value to addressing extreme hunger and food security output in the population (Verma, Sahoo & Rakshit, 2018). In a collaborative approach to addressing farm output, the pursuit of agricultural sustainability has to be domesticated by agri-preneurs who are social entrepreneurs in mind-set, and willing to uplift rural farmers to fight against farm insecurity and increase farm productivity (FAO, 2018). Report from FAO (2018) opined that the dual aim of the United Nations' second sustainable development goal (SDG-2) required urgent and concerted action from developing and developed countries to develop applicable targets and indicators for farm productivity.

Evidence from International Institute of Tropical Agriculture [IITA] synthesis report (2017) showed that the per capita food supply per day dropped steadily from 2,720kcal (2007), 2706kcal (2011) and further down to 2690kcal (2015), which exposed that Nigeria is experiencing food insecurity and farm productivity is a major concern. The aggravating demand for starvation reduction and farm productivity output improvement have been met with failure mostly in developing countries (Cochrane et al., 2017; Mellor, 2017; World Bank, 2016; African Development Bank [AfDB] 2018). Alliance for a Green Revolution in Africa [AGRA] (2018), Regan, Stuart and Paul (2018) have centered on smart agri-preneurship as a pro-economic tool to address food security output in developing nations. Awojide, Simon, and Akintelu (2018) opined that new studies from the Nigerian perspective, have limited constructs, hence the need to investigate the effect of smart agri-preneurship (greenhouse farming, hydroponics, geo-mapping, drone agriculture, soil analysis) on farm productivity. This paper is structured as follows: introduction, literature review, methodology, results and discussions, and conclusion.

Literature Review

The term smart agri-preneurship is a combination of three concepts-smart technology, agribusiness and entrepreneurship. Agribusiness is defined according to Price water house Coopers (PwC) (2016) as a large-scale business operation, embracing the production, processing and distribution of agricultural products and the manufacture of farm machinery, equipment and supplies. It was first introduced in 1957 (David, 2016) with a focus on size, excluding small business operations such as family farms. It refers to agriculturally related businesses, including warehouses, wholesalers, processors and retailers (Chait, 2014). Entrepreneurship, on the other hand, in this context is connected with finding ways and means to create value, add value, and develop a profitable agribusiness. Paul, Amarachi, Oyedele, Odafe and Juliana (2018) defined entrepreneurship in agriculture as the creation of an innovative economic organization for growth or gain under conditions of risk and uncertainty. Nwibo and Okorie (2013) explained that such an entrepreneur is an individual willing to expand an agricultural venture using inherent unique leadership and managerial skills.

Smart technology, on its own, refers to the scientific approaches, systems and gadgets that aid data tracking, efficiency improvement and are environmentally friendly (Osabohien, Osabuohien & Urhie, 2018). Clark et al. (2019) added to the definition by stating it as an enhancer of food productivity using technology and innovative approaches. Hence, the term smart agripreneurship was defined by Cains and Henshel (2019) as the profitable union of agriculture, climate awareness, technology and entrepreneurship to turn farms into successful agribusinesses. Cains and Henshel (2019), Osabohien et al. (2018) further explained that it requires applying the basic requirements, advantaged information and environmental modifications to optimize the operation of a current agribusiness. Smart agri-preneurship which is a product of innovativeness has been identified to progressively have a direct effect on product quality, profitability, and healthy environment and agribusiness performance to the extent that it weakens hegemony by disrupting agribusiness (Rehman & Shaikh, 2014). Although agri-preneurship embodies entrepreneurship in the agribusiness, smart agri-preneurship alludes entrepreneurship in agribusiness driven by modern efficient technology that is climate-friendly.

Farm Productivity

According to Alston, Beddow, and Pardey (2009), farm productivity is the measurement of the quantity of agricultural output produced for a given quantity of input or a set of inputs. There are different ways of defining and measuring productivity. The amount of output per unit of input (such as tons of wheat per acre of land), or an index of numerous outputs divided by an index of numerous inputs (Wiebe, 2003). The quantities of output relative to the number of inputs are the conventional measures of productivity. If output increases at the same rate as inputs, then productivity is unchanged. Productivity refers to the rate of output per unit of labour, capital or equipment (input). Those leading and managing farm businesses are assessing the ability of their businesses to survive under different opportunities (Barwa, 2014).

Sheng and Chancellor (2019) opined that productivity of a farm can be measured by how long it takes to produce specific produce. Productivity is measured by comparing the number of goods and services produced with the inputs which were used in production. Every smart agri-preneur has a primary goal or objective to own or be affiliated to a productive agribusiness irrespective of whether s/he has a big value chain (Clark et al., 2019). Aiming at being productive, smart agri-preneurs are faced with many factors limiting farm's productivity, such as available land, labour, soil fertility, agricultural commodities, weather conditions, crops, taste, market access, farmer's knowledge and lack of new technologies (Gupta & Kaushal, 2018). Agribusinesses need to be led by agri-preneurs who use capital investment and technology to improve total factor productivity and reduce unit costs of production (Gulati, Sharma, Samantara & Terway, 2018).

Farm productivity depends largely on focus, not having the right focus on the right things can become one of the productivity problems (Ariani, Hervani & Setyanto, 2018). Beyond understanding smart agri-preneurship performance in agribusiness, it is also important to understand its positive effect on the environment and yield per acre for each variety and most importantly to create ease of entry for other smart agri-preneurs (Velde & Nisini, 2019). Farm productivity in smart agribusiness is also important for spurring economic growth in other sectors. According to the World Bank (2014), farmers in remote rural areas accounts for 75% of the world's poor population. In Africa, productivity in agriculture lags when compared globally and is below the required standards of achieving food security output, poverty goals and food sufficiency (Masipa, 2017).

Smart Agri-preneurship and Farm Productivity

The varied opinions on smart agri-preneurship and modern agricultural systems has been a central point of argument and has gotten considerable attention in recent years from academics, professionals, regulators and the government of nations. It continues to receive maximum attention because of the economic contributions of the agribusiness sector towards food security output, the standard of living, economic growth and development, while at the same time the empirical evidence on the subject remains inconclusive. A review of the empirical evidence on the impact of smart agri-preneurship dimensions on-farm productivity showed mixed results. Studies by Carrer, Souza and Batalha (2019), Aatif, Kaiser, Showket, Prasanto and Negi (2018) and YiHsuan, Ssu-Pei and Ting (2019) have established that smart agri-preneurship has a positive and significant effect on-farm productivity, enhanced food security output and revenue generation for the farmers. Similarly, the Economic Community of West African States [ECOWAS] (2015) emphasized on the importance of modern agriculture farming techniques, especially in developing economies and concluded that smart agri-preneurship has a positive and significant influence on farm productivity.

The studies of Gasparatos et al. (2017), and Tripathi and Agarwal (2015) revealed that greenhouse and drone agriculture farming is designed to create optimal agricultural productivity and value- adding to the agri-preneurs' output. Asrat and Simane (2018) and Tom (2016) found that utilizing soil analysis, geo-mapping and nutrient cycling approach in croplands are ecologically sound, climate friendly and significantly enhance farm productivity and food security output. Praveen and Sharma (2019) established that soil analysis enhances farm productivity and food accessibility. Bairwa, Lakra, Kushwaha, Meena, and Kumar (2014) distinctively confirmed smart agri-preneurship development and its dimensions, uplifts agribusiness and positively increase food and farm productivity. On the contrary, few studies, like Verma, Sahoo and Rakshit (2018) found that there is an insignificant relationship between smart agri-preneurship and farm productivity in some Indian agribusinesses. Laud (2018) also revealed a negative relationship between smart agri-preneurship and farm productivity, especially in developing countries.

Theoretically, the Lewis theory which was propounded by Arthur W. Lewis in 1954 is used to underpin this work. The Lewis theory focused on how the traditional farmer can employ innovation and become modern farmer which enhance farmer creativity, creation of wealth and increase in productivity. Lewis model theory guides this paper's discourse because its assumptions are keen to how agri-preneurs become modernized and creative to gain increase in agribusiness profitability, farm productivity and food security output. The justification is based on the theoretical robustness and explanations as it relate to the variables in the work. The primary assumption of Lewis theoretical model is on both the process of labour transfer and the growth of output and employment in the modern agriculture sector. Both labour transfer and modern-sector employment growth presupposes that 99% output expansion in that modern agriculture sector by entrepreneurs make profit above the fixed rate by adding value.

However, it has been criticized by Mezzera (1989) and Todaro (1969), as it turned on the validity of its central postulates, that the subsistence sector in developing countries contains an abundance of labour, ensuring that the conventional wage in the subsistence sector rules over the entire economy. Absorption of surplus labour itself may end prematurely because competitors may raise wage rates and lower the share of profit. Other criticisms interpreted the Lewis model as advocating industrialisation and agricultural development but neglect other sectors that can enhance economic development. Furthermore, Romeo, Vea and Thomsen (2018) emphasized that modern agri-preneurs employed smart agri-preneurship measures such as Green House Farming (GHF), Hydroponics (HP), GeoMapping (GM), Drone Agriculture (DA), Nutrient Cycling (NC) and Soil Analysis) in order to gain market opportunity and increased in food security output towards economic growth and development.

Methodology

Cross sectional survey research design was used for the study. This research design is appropriate because it enables the researchers to collect data that represents the perception of people across a large geographical area, and at a categorical time-frame. The adoption of this design is consistent with the studies of (Tammo, Ellen, Gersom & Eunice, 2017; Suryabhagavan, Asfaw & Argaw, 2016; Steven & Anne, 2016; Shoji, KerobimLakra, Kushwaha, Meena & Pravin, 2014; Kuforiji, Egwakhe & Binuyo, 2019). The unit of analysis was the agri-preneurs who own or manage the agricultural firms. The justification for this unit of analysis is based on the fact that the smart agri-preneur is at the top of the leadership team responsible for vision, innovation and effective communication of the ideas.

A total population of six hundred and thirty two (632) agri-preneurs within the South-Western states in Nigeria was filtered to reflect only duly registered firms with the Ministry of Agriculture of the respective states that have kept proper records of their farm production output. Based on this elimination criteria, the population arrived at became a finite population size of five hundred and fifty-eight (558) and also adopted as the sample size of the study using the Cochran (1997) formula. A structured questionnaire was adapted from previous studies (Singh, 2017; Amone, 2017; Al-Houti, 2017; El Ghoumari, Tantau, and Serrano, 2005; Kibiti and Gitonga, 2017; Admane, 2013; Harrell, 2014; Peuralahti, 2014; Al-Arab, Torres-Rua, Ticlavilca, Jensen, and McKee, 2013; Hafsal, 2016; Gordon, 2004; Pettersen, 2014) along the constructs with sections capturing demographic information, Smart agri-preneurship dimensions (greenhouse farming, hydroponics, geo-mapping, drone agriculture, nutrient cycling and soil analysis) and farm productivity which was measured as a whole using a likert scale ranging from very high (6) to very low (1).

Pilot testing was carried out to test the construct and content of the research instrument and validation and reliability were confirmed through Kaiser-Meyer Olkin (KMO) > 0.6, Bartlett's test < 0.05, Composite reliability > 0.7, Average Variance Extracted > 0.5 and scores from Cronbach's Alpha Coefficients > 0.7 respectively. The pilot study was undertaken in selected farms within the North central area of Nigeria, covering Kwara State and Benue State, largely because these agriculture firms were outside the study area. Afterwards, copies of the questionnaire were distributed and retrieved by well-trained research assistants. The researchers developed a structured econometric model for the study using the main constructs, and the data was analysed using multiple regression analysis.

Model Specification

In order to determine the effect of smart agri-preneurship (X) on farm productivity (Y), an econometric model was developed.

$Y = f(X)^n$.

Hence the model was structured as such;

$$FP = a_0 + \beta_1 GHF_i + \beta_2 HP_i + \beta_3 GM_i + \beta_4 DA_i + \beta_5 NC_i + \beta_6 SA_i + \mu_i \text{.......} \quad eq.\ 1$$

Where

β_1= Green House Farming (GHF)

β_2= Hydroponics (HP)

β_3= Geo-Mapping (GM)

β_4= Drone Agriculture (DA)

β_5= Nutrient Cycling (NC)

β_6= Soil Analysis (SA)

μ_i = Error term

The paper's *apriori* expectation is pillared on the assumption that the dimensions of smart agri-preneurship will exhibit individual and collective positive significant effect on farm productivity.

Results and Discussion

The thesis of the work focused on examining the effect of smart agri-preneurship dimensions on farm productivity in South-West, Nigeria. Multiple regression analysis was used to test the hypothesis with farm productivity as the dependent variable, and smart agri-preneurship dimensions as the independent variable. Data from five hundred and fifty-eight (558) respondents were gathered and analyzed using SPSS version 23 software. The results of the multiple linear regression analysis are shown in Table 1.

Table 1: Multiple regression analysis Result on Smart agri-preneurship and farm productivity in South-West, Nigeria

Coefficients[a]						
		Unstandardized Coefficients		Standardized Coefficients	*t*	Sig.
		β	Std. Error	Beta		
1	(Constant)	0.060	0.140		0.428	0.668
	Green House Farming	0.128	0.045	0.118	2.870	0.004
	Hydro phonics	0.100	0.044	0.100	2.276	0.023
	Geo-Mapping	0.225	0.035	0.240	6.344	0.000
	Drone Agriculture	0.033	0.017	0.051	1.956	0.051
	Nutrient Cycling	0.203	0.037	0.207	5.570	0.000
	Soil Analysis	0.284	0.037	0.287	7.671	0.000

a. Dependent Variable: Productivity
b. R = 0.821[a] R^2 = 0.675 Adj. R^2 = 0.671
c. F (6, 551) = 190.420 (p=0.000)

Source: Field Survey, 2020

The result of the multiple regression analysis showed the model summary (R^2 and adjusted R^2) of the effect of smart agri-preneurship on farm productivity in South-West, Nigeria. The coefficient of determination (R^2) value in the analysis is 0.675 which indicates that smart agri-preneurship dimensions have a moderate positive and significant effect on farm productivity. The coefficient of multiple determination, adjusted R^2 is 0.671 (F(6, 551) = 190.420, p=0.000) revealed that smart agri-preneurship explained 67.1% of the changes in farm productivity in South-West, Nigeria while the remaining 32.9% could be attributed to other factors not included in this model. Also, the F-statistics (df = 6, 551) = 190.420 at p = 0.000 (p<0.05) indicate that the overall model is significant in predicting the effect of smart agr-preneurship dimensions on farm productivity. This means that smart agri-preneurship significantly affected farm productivity.

Table 1shows the results from the analysis on smart agri-preneurship dimensions (green house farming, hydro phonics, geo-mapping, drone agriculture, nutrient cycling and soil analysis) on farm productivity. From the results, it was revealed smart agri-preneurship $F(6,551) = 190.42$, $p = 0.000$) had positive significant effect on farm productivity. The individual effect indicated that green-house farming ($\beta = 0.128$, $t = 2.870$, $p<0.05$), hydro phonics ($\beta = 0.100$, $t = 2.276$, $p<0.05$), geo-mapping ($\beta = 0.225$, $t = 6.344$, $p<0.05$), drone agriculture ($\beta = 0.033$, $t = 1.956$, $p=0.05$), nutrient cycling ($\beta = 0.203$, $t = 5.570$, $p<0.05$) and soil analysis ($\beta = 0.284$, $t = 7.671$, $p<0.05$) had positive and significant effect on farm productivity in South-West, Nigeria. Although the proxies of smart agri-preneurship were statistically significant, the related effect differs in relation to farm productivity with soil analysis exhibiting the highest effect, followed by geo-mapping and nutrient cycling respectively.

The values (adjusted R^2 is 0.671 ($F(6, 551) = 190.420$, $p=0.000$) inform that the model is statistically robust to predict the effect and that holding smart agri-preneurship dimensions constant, farm productivity would be at a positive value of 0.060. In addition, the regression model explains that when green-house farming, hydro-phonics, geo-mapping, drone agriculture, nutrient cycling and soil analysis are improved by one unit, farm productivity would also increase by 0.128, 0.100, 0.225, 0.033, 0.203 and 0.248 units respectively. This implies that an increase in smart agri-preneurship dimensions (green house farming, hydro-phonics, geo-mapping, drone agriculture, nutrient cycling and soil analysis) would lead to a subsequent increase in farm productivity in South-West, Nigeria.

Discussions and conclusion

The result above reveals that smart agri-preneurship dimensions significantly affected farm productivity. The finding is consistent with the findings of Marcela et al. (2017), Masrin et al. (2018), Carrer et al. (2019) and Aatif et al. (2018) who investigated how unmanned aerial vehicle (UAV) or drone enhance farm productivity and yield. In addition, Gulati et al. (2018) is sustained that drone with pesticides and fertilizers use enhanced the crop yield quality. Others like Gasparatos et al. (2017), Adebiyi et al. (2018), Eme et al. (2014), and Ahirwar et al. (2019) whose existing works revealed that drone technology has significantly improved farm productivity is corroborated. The notion, as forwarded by Kooijman et al. (2018), Lamley and Adams (2018) and JanWillem et al. (2018), is empirically sustained through the findings that utilizing smart agri-preneurship approach in nutrient cycling is ecologically sound, climate friendly and significantly enhances farm productivity and food security output. On the contrary, Waleed (2018), Saidu, et al. (2017), Shaimaa et al. (2015), Payraudeau et al. (2005) and Shoji et al. (2014) do not support the finding which could be attributed to context, construct and methodoligical differences.

The researchers investigated the concept of smart agri-preneurship dimensions on farm productivity in south-west, Nigeria with the results indicating positive and significant influence on farm productivity. It was observed that the use of advanced and scientific technologies and knowledge could help increase farm productivity. While the findings are intended to deepen academic insight, its practical approach and utilization of the findings to encourage investment in Agriculture remain imperative. The study recommends that a renewed and deliberate introduction and deployment of smart technology by entrepreneurs into farming activities could increase farm productivity. Undoubtedly further field research will also be needed to deepen understanding on the role of climate change on the interaction between smart agri-preneurial and farm productivity.

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