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RESEARCH ARTICLE

Effects Of Human Capital Development On Food Security In South East, Nigeria: Bridging The Skills Gap In Agro-Industry

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Abstract

Food insecurity remains a pressing challenge in Nigeria, particularly within the agro-industry, where a significant skills gap continues to hinder optimal productivity. This study aims to examine the effect of Human Capital Development (HCD) on food security by identifying the extent to which bridging skill deficits can enhance agricultural outcomes. The research focused on 150 agro-farmers selected through a multistage sampling method, employing descriptive statistics and multiple regression analysis to assess the relationships. The analysis revealed a strong positive correlation between HCD and food security, showing that improvements in agricultural technology skills, research and development capacity, environmental awareness, and extension services directly contribute to increased food availability. Results indicate that a 1% increase in relevant skills can lead to a measurable rise in food production and accessibility. The findings underscore the critical need for targeted training, strategic capacity-building programs, and stakeholder collaboration to close the prevailing skills gap. These interventions are essential for boosting agro-sector productivity, improving national food security, and achieving long-term agricultural sustainability in Nigeria.

Keywords: Human Capital Development, Food Security, Agricultural Skills Gap, Agro-Industry, Nigeria, Agricultural Productivity, Sustainable Agriculture, Skills Mismatch

1.1 Introduction

Human capital (HC) is the collection of skills, knowledge, and personal attributes that support individual's ability to achieve labor and generate economic value. Unlike physical assets like land or machinery, HC is not transferable but improvable through investments that can lead to increased output. HC is necessary for organizational success and growth through education and experience (Ndibe, 2022). In modern economic theory, the concept of human capital is considered a key driver of economic growth (Djomo & Sikod, 2012) positing that investment in education, skills, and health enhances individuals' capacity to contribute effectively to economic activities. Consequently, human capital has become the foundation and major driver of innovation and economic growth in most countries including Nigeria.

HCD represents the aggregate value of individuals within an economy and encompasses various qualities such as talents, skills, training, and wisdom (James, 2021). Beyond physical capital, human capital development includes knowledge, technical skills, experience, health, intelligence, and other personal traits that significantly boost productivity. In today's competitive and interconnected global economy, intangible resources have become increasingly valuable, with human capital emerging as a critical component of food security (Sergeevna, Aleksandrovich, Ivanovna, Vladimirovna, Nikolaevich & Germanovich, 2020).

Food security exists when all people always have economic and physical access to sufficient, safe, and nutritious food to satisfy their dietary needs and food preferences for an active and healthy life (Okpala, Korir & Manning, 2024; Abubakar, 2021; Maduna-Mafu, 2015). Contextually, National food security denotes guaranteed quantity and quality food supply along with its availability, accessibility, and affordability overtime across income levels within the population. This concept encompasses four key dimensions: food availability, food access, food

utilization, and food stability. When these components are ensured, a nation is said to have achieved food security, minimizing the risks of hunger, malnutrition, and food-related social unrest (FAO, 2008). Therefore, a strategy involving a general pathway to achieving sustainable overall goals under uncertainty (Tanaka, 2022) must be carefully designed to achieve food security.

Unfortunately, the problem of food security in Nigeria, as in other developing nations, is very critical, and the issues are currently on the front burner. Food availability, quality, and affordability are basic problems across households in Nigeria. Despite various agricultural programs being implemented by successive governments, poverty, hunger, and malnutrition are still unacceptable (Kainga et al., 2016). This is more so by the peculiar hyper – turbulent and endemic unethical issues in Nigeria and Africa generally. Empirical studies found evidence that human capital is positively related to agricultural productivity (Anyanwu et al., 2015), implying that it is important to agricultural production, particularly because it increases productivity and is central to economic activities, growth, and development following its central position in the production, distribution, and consumption chains. Ndibe (2022) asserts that "human capital development facilitates technological innovations, increases returns to capital and makes growth in agriculture more sustainable." Investing in the human capital base is regarded as a strategic way to improve agricultural productivity (Nyamkye, Fiankor & Ntomi, 2016).This study seeks to examine the effect of human capital development on food security in South-East, Nigeria, focusing on bridging the skills gap in the agro-industry. Understanding this linkage is vital for formulating strategic interventions that empower farmers with the requisite competencies to adopt efficient and sustainable practices, improve productivity, reduce food loss, and ultimately secure the nation's future.

1.2 Statement of the Problem

Despite Nigeria's immense agricultural potential and numerous government-led initiatives to achieve food sufficiency, the nation grapples with persistent food insecurity. Food and Agriculture Organization projects that Nigeria accounts for over 24.8% of undernourished individuals in West Africa FAO, 2022). The agricultural sector, predominantly driven by smallholder farmers, lacks formal training, modern agricultural knowledge, and access to skill-enhancing opportunities. In addition, many practitioners rely on rudimentary farming techniques, suffer from low productivity, and have limited access to extension services or innovations in agro-technology (Ohanado, 2021). Such statistics in a nation like Nigeria, endowed with vast arable land and a youthful population is disturbing. The lack of essential skills in post-harvest handling, irrigation, mechanization, and climate-smart practices has aggravated decline in food production with an estimated 40–50% yearly losses after annual harvest of crops. This has further worsened the country's food security crisis. Food insecurity is not solely a result of environmental or economic challenges but is significantly compounded by the critical gaps in human capital development, particularly within the agro-industry.

Human capital development, encompassing education, vocational training, skill acquisition, and research-based innovations, plays a critical role in enhancing agricultural productivity and ensuring food availability, accessibility, and affordability (Ndibe, 2022; Nyamkye, Fiankor & Ntomi, 2016); however, with the existence of such significant skills gap, among rural farming communities, who are least equipped to benefit from modern agricultural advancements. Above

all, the lack of empirical data and scholarly Research linking human capital development to food security outcomes in Nigeria's agro-industry is compounding this issue. While there is substantial literature on general agricultural productivity and food insecurity, few studies have examined the measurable impact of skill development and human resource capacity on food availability, accessibility, and utilization in the Nigerian context.

Despite the potential for agricultural growth, food insecurity in Nigeria is on the rise. Recent data from the Food and Agriculture Organization (FAO) shows that Nigeria is home to over 24.8% of undernourished people in West Africa (FAO, 2022). This problem is aggravated by inadequate human capital development. With the Nigerian agricultural sector dominated by unskilled or semi-skilled smallholder farmers who often rely on traditional farming methods that limit their productivity, modern skills necessary for modern, efficient farming are missing; HCD should encapsulate education, skill acquisition, training, and innovation for improving productivity in agriculture. According to Ohanado (2021), one of the major barriers to agricultural productivity is the poor state of human capital development among farmers, most of whom have limited training and education on agricultural technology, research and development, extension services, and environmental awareness.

Farmers in Nigeria have low technical competencies that tend to be serious retardants to food production in the country. Farmers' continuous dependence on rain-fed agriculture without irrigation facilities undermines the yields of crops. Following poor management and storage of fresh produce, Nigeria loses about 40-50% of yearly produce after harvest, showing total technical incompetence in the modern farming business (Ohanado, 2021)

This gap in data and contextual analysis limits the ability of policymakers, development agencies, and educational institutions to design targeted interventions. This study seeks to address a critical research gap by investigating the effect of human capital development on food security in the South East, Nigeria with a specific focus on bridging the skills gap agro-industry. By generating context-specific evidence, the study aims to support informed decision-making and contribute to designing strategic, inclusive, and sustainable human capital development programs that can drive innovation, increase productivity, and improve food security outcomes across Nigeria.

1.3 The Objectives of the Study

The present study seeks to investigate the effects of human capital development on food security in South-East, Nigeria Agro-industry. The specific objectives seek to:

i. Determine human capital development skills awareness amongst farmers in South-East, Nigeria.
ii. Investigate the effect of human capital development on optimal food production in South-East, Nigeria;
iii. Examine the effect of human capital development on food security in South-East, Nigeria

2. Conceptual Review

2. 1 Overview of Human Capital Development and its components

Human capital development (HCD) is the process of enhancing individuals' skills, knowledge, abilities, and productivity within a population. Human capital development is associated with investment in man and his development as a creative and productive resource (James, 2021). Most early economic theories refer to human capital simply as the workforce, one of the factors of production, which is considered a fungible resource that can easily be replaced with another (Djomo & Sikod, 2012).

Economically, James (2021) describes capital as a factor of production used in creating goods and services but not consumed in the process, with the human element driving economic activities such as production, consumption, and transactions (James, 2021). In his pioneer studies, Schultz (1954) associated human capital with formal schooling that made farmers more productive. Also, the term was first used in the modern economic literature by Schultz in 1961 (Fleischhauer, 2007; Djomo & sikod, 2012) in classifying expenditures on human capital as investment as against consumption. Subsequently, in its first application, Fleischhauer (2007) explains that "human capital is similar to physical means of production" and that investing in human capital involves "all activities that influence future real income through the embedding of resources in people."

Human capital development is classified into six components: i) Agricultural technology, which includes investment in training on pieces of machinery and data management ii) management skills, which includes managerial training organized by firms; iii) formally organized education at elementary, secondary, and tertiary level; iv) marketing skills v) Research and development; (vi) environmental awareness; (vii) communication and interpersonal skills and viii) extension services (Olukosi & Erhabor 2021; Cappeli, 2012).

Human capital investments include expenditures on education, training, health, information, and labor mobility (Cappeli, 2012). Accumulation of human capital happens in three different ways, namely: formal schooling (where the individual devotes his whole time to learning), on-the-job training (post-school training provided by the current employer), and off-the-job training (post-school training provided by "for-profit" proprietary institutions). These investments involve initial costs to gain a return on the investments in the future. The return on investment is based on two interrelated channels: increased earnings for the worker and higher productivity for the firm (Fleischhauer, 2007). HCD aims to increase individuals' capacity to perform labor efficiently, adapt to new challenges, generate economic value, and promote societal well-being. Numerous studies have identified human capital as a key factor in any nation's economic growth, productivity, and long-term development (Brodny & Tutak, 2024; Carillo, 2024; Gruzina & Strielkowski, 2021).

2.2 Relationship between Human Capital Development and Food Security

The relationship between human capital development (HCD) and food security is fundamental and multidimensional (Kumar, Chand, Sharma, & Thakur, 2025). It has been argued that food security correlates with human development, and any significant progress on one affects the

other (James, 2021). The four pillars of HCD—education, Research and development, environmental awareness, and communication skills (Ndibe, 2022)—are catalysts for improved agricultural productivity, innovation, and resilience, essential components of sustainable food systems.

Human capital has been identified as a key driver of increasing productivity and agricultural income, thereby reducing food insecurity (Ndibe, 2022). Illiteracy reduces the capacity to undertake high-income paid jobs. It restricts households to low-income jobs (menial jobs), which reduces accessibility to consumable food, thereby elevating household food insecurity. Educated and skilled farmers are more likely to adopt modern agricultural practices, apply advanced technologies, and implement better farm management strategies, ultimately leading to increased food production. According to Okpala, Korir, and Manning (2024), farmers' productivity is significantly influenced by their access to education and training, especially in areas like agricultural technology, environmental management, and value chain processes.

In today's hyper-turbulent economy and climate change, human capital heightens the capacity of individuals and communities to adapt. Knowledge-based agricultural practices, accessibility to extension services, and relevant training help farmers mitigate risks in droughts, floods, and market fluctuations (FAO, 2022). Knowledge-based Agricultural practices improve resilience, reduce vulnerability, and ensure stable food availability. Human capital development fosters research and innovation within the agricultural sector. Investment in education and research is justifiable for increasing production in agriculture and guaranteeing long-term food availability (Nyamkye, Fiankor & Ntomi, 2016).

Education and skills development also improve farmers' access to credit, information, and markets. Literate and skilled individuals are better able to engage with financial institutions, government programs, and digital platforms, which enhances their income and ability to purchase or produce sufficient food. Ndibe (2022) observes that human capital is a productivity enhancer and driver of economic inclusiveness that ultimately improves the accessibility and affordability of food.

Beyond availability, food security encompasses utilization—how food is consumed and whether it meets dietary needs. Human capital plays a role because educated households are more likely to make informed nutritional choices and adopt healthy food practices (FAO, 2022). A strong, evidence-based link exists between human capital development and food security. Education, skill-building, health, and access to information all contribute to more productive, efficient, and resilient food systems. Bridging the skills gap in Nigeria's agro-industry through strategic human capital investment is necessary to achieve national food security goals.

Poor Research results from a lack of agricultural research facilities, which is a constant feature of most rural areas in Nigeria. Possession of communication skills increases household opportunities available to engage in essential jobs which can significantly improve their income and welfare. Hence, lack of skill disqualifies most households from those essential jobs, which invariably reduces income and translates to food insecurity. The problems associated with food insecurity during food turbulent period are long-standing in rural communities (Olukosi & Erhabor, 2021). Thus, since about half of Nigeria lives in rural areas (World Bank, 2022),

examining the factors associated with food insecurity is important if progress should be made toward achieving the second Sustainable Development Goal of zero hunger in rural households.

2.3 The Current State of Nigeria's Agro-Industry

Agriculture has been a long-standing practice in developing and third-world countries. Its significance for socio-economic growth and development is crucial for these nations' progress toward economic prosperity. Agriculture accounts for over a quarter of the GDP in many developing countries, including Nigeria, with even higher contributions in the least developed countries (World Bank, 2007). The World Bank's development reports (2007) indicate that agriculture is vital for the livelihood of over 2.5 billion people globally. The agricultural sector directly or indirectly involves a substantial portion of the global population through its value chain. In the 1960s, Nigeria was an agricultural economy and among the world's leading producers of cocoa, palm oil, groundnuts, cotton, rubber, and hide and skin (Penda, 2012). At that time, the sector contributed over 60% to the GDP, but today, agriculture contributed only 25.24% of the total GDP in the year 2023, which is even seen to be an increase from the last quarter of 2020 (NBS, 2024). Nigeria's agricultural sector faces many challenges that impact its productivity, including poor land tenure system, low irrigation farming, climate change, land degradation, low technology, high production cost, poor distribution of inputs, limited financing, high post-harvest losses, and poor market access. Although the government has embarked on numerous initiatives and programs, the Agriculture Promotion Policy (APP), Nigeria-Africa Trade and Investment Promotion Programme , Presidential Economic Diversification Initiative, and Economic and Export Promotion Incentives, among others, aimed at increasing agricultural productivity for both domestic demand and export (FAO, 2008), the result is still below expectation.

Factors making these problems more pronounced are the general demographic trends in third-world nations, meaning that more mouths must be fed. As of Wednesday, September 14, 2024, the population of Nigeria was estimated to be 232,679,478 people. This is an increase of 8.8 percent compared with the population of 206,139,589 in 2020. Nigeria will be the third most populous country in the world by 2050, standing behind just India and China (Worldometer, 2024). Nigeria's population, currently the seventh largest in the world, is growing most rapidly and is projected to surpass that of the United States by about 2050. At this point, it will become the third largest in the world. Volatility in global food prices, fluctuations in the value of naira, and high inflation rates have led to price increases for domestic and imported foods. Import bans, intended to favor the local economy, have increased domestic market prices by limiting the availability of commodities and raw materials (Gruzina et al., 2021). Nigeria's raw food system is market-based, and 75 percent of the food consumed in rural areas is purchased. Accordingly, lower-income households are vulnerable to volatile circumstances and externalities that impact food prices and availability. Lack of storage facilities and high levels of post-harvest loss also reduce household food availability (Suleiman, 2014).

According to a report by the International Institute of Tropical Agriculture (IITA) (2022), only 15% of Nigerian farmers use improved seed varieties, while less than 10% have access to machinery such as tractors. The low level of mechanization is particularly concerning, given Nigeria's large agricultural workforce. Nigeria has approximately 10 tractors per 100,000 hectares of arable land, compared to countries like Brazil and India, which have 200 and 120

tractors per 100,000 hectares, respectively (Food and Agriculture Organization, 2022). The lack of technological competencies also limits the ability of farmers to implement sustainable agricultural practices. Unsustainable farming methods, such as overuse of chemical fertilizers and poor land management, contribute to soil degradation and deforestation, undermining long-term food security. In contrast, countries that have embraced sustainable technologies, such as Kenya and Rwanda, have seen significant increases in agricultural productivity and resilience to climate change (Food and Agriculture Organization, 2022).

2.4 Skills Gap in Nigeria's Agro-Industry

Nigeria's agro-industry holds vast potential to drive economic growth, create jobs, and ensure food security in most sub-Saharan African countries, with one-third of total Gross Domestic Product (GDP) being contributed by the sector (Nyamkye, Fiankor, and Ntomi, 2016). The sector employs over 65% of the workforce in most sub-Saharan Africa (SSA), with over 80% of the African population depending on it as a source of livelihood (International Food Policy Research Institute, 2013; World Bank, 2013; Muguna, 2015; Ndour, 2017). According to the study by IFPRI in 2012, agriculture would remain the dominant potential source of employment for the rising rural population in sub-Saharan Africa (International Food Policy Research Institute, 2013), and productivity growth in agriculture is critical for food security, economic growth, development, and poverty reduction (Nyamkye, Fiankor & Ntomi, 2016). For poor households in Africa, agriculture is a mechanism to provide the means to cover food expenditure and improve nutritional status. However, the agro-industry in Nigeria faces a wide skills gap that hinders innovation, productivity, and competitiveness. The disconnect between the competencies required for modern agribusiness and the available skill set of the agricultural workforce, particularly smallholder farmers, has been widely reported. Despite the sector's crucial role in the nation's economy, contributing over 25% of GDP and employing a substantial portion of the population, there is a noticeable deficiency in skilled labor (World Bank, 2022).

Several studies underlined the inadequate technical, entrepreneurial, and managerial capabilities among key actors in the agricultural value chain, which are necessary for enhancing productivity and efficiency (Olukosi & Erhabor, 2021). Ohanado (2021) notes that most smallholder farmers have limited access to formal education and agricultural extension services, making it difficult to adopt innovative practices or benefit from modern inputs and technologies. This gap is further widened by poor curriculum alignment between agricultural training institutions and the real-world demands of agro-industrial value chains. Several skills mismatch persists in agricultural technology, post-harvest handling, mechanization, climate-smart farming, and agripreneurship. Olumide et al. (2022) highlight that over 70% of Nigeria's agricultural workers depend on outdated farming practices, resulting in low productivity, losses, and poor investment in HCD (Akinbile & Ojo, 2015).

For instance, inadequate knowledge in preservation, processing, and value addition results in the loss of nearly 40% of perishable produce annually, exacerbating food insecurity and economic waste (Olumide et al. (2022). The gap is exacerbated by migrating young, skilled workers to urban areas for better opportunities, leaving the agricultural sector with an aging and less technically adept workforce (Ogunlela & Mukhtar, 2012). Despite Nigeria's large and youthful population, many young people still lack the expert training and capacity to exploit opportunities in agribusiness (FAO, 2023). There is a deficit in digital and data-driven skills essential in

today's agritech-driven global food systems. Kuye and Eze (2023) argue that bridging these skills divide requires a shift toward practical, competency-based training and stronger public-private sector collaboration to develop demand-responsive capacity-building programs.

Closing the skills gap is a prerequisite for improving agricultural productivity and a necessary condition for transforming agriculture into a viable and attractive sector for youth employment and innovation. Thus, deliberate investments in human capital development— a concerted effort to improve agricultural education and vocational training, Research and development, and technical education—are critical to creating incentives to attract and retain skilled professionals in the agro-industry (Nwachukwu, 2020) that can drive the sector's transformation.

3. Theoretical Framework

3.1. Human Capital

Human capital theory suggests that individuals and society derive economic benefits from investments in people. The theory further suggests that education and training are investments that make individuals genuinely more productive. According to the theory, more productive individuals are expected to have higher earnings and be more employable. Hence, the investment feature of this theory significantly differentiates human capital expenditures from consumptive expenditures (those providing few benefits beyond immediate satisfaction (Cappeli, 2012). Also, this theory shows how education leads to an increase in the productivity and efficiency of workers by increasing the level of their cognitive skills. According to James (2021), investment in education is seen as a productive investment in human capital, an investment that proponents of human capital theory consider equally or even more worthwhile than that in physical capital. Education is a key to creating, adapting, and spreading knowledge.

3. 2 Skill Theory

The Skill gap theory, as articulated by Rosenbaum (2001), examined the discrepancy between the skills that employers require and those possessed by workers. This theory highlights that skill gaps arise when educational and training systems fail to keep pace with the evolving demands of the job market, leading to inefficiencies in employment and economic performance. Rosenbaum argues that these gaps are particularly pronounced when there is a rapid technological advancement or shifts in industry requirements that educational institutions and vocational programs struggle to address.

Despite the potential for the agricultural sector in Nigeria for food security and economic development, productivity remains suboptimal. Nigerian Smallholder farmers and agro-entrepreneurs lack access to mechanized farming, effective agribusiness management, sustainable agricultural practices. Agricultural curricula in most academic institutions are outdate, failing to prepare graduates with relevant skills for practical agro-industrial issues (Anyanwu et al., 2015; Nyamkye et al., 2016).

The underperformance is partly due to a persistent skill gap—the disparity between the skills employers need and the skills workers possess. The skill gap theory posits that economic inefficiencies and labor market mismatches stem from discrepancies between education/training

outcomes and job market requirements (ILO, 2020). The current misalignment should be addressed to provide a robust framework for analyzing the challenges in Nigeria's agro-industry. Nigerian agro-based economies require a dynamic and responsive skill development system to meet evolving industry demands (OECD, 2022). This theory underpins the need for sector-specific, demand-driven training interventions in the Nigerian agro-sector.

4 Methodology

The study adopted a quantitative multi stage design to collect data. This study was conducted in the Southeast Agro-ecological zone of Nigeria. The Southeast zone comprises five states: Abia, Anambra, Ebonyi, Enugu, and Imo. The states are within the Southeast rainforest zone of Nigeria. The area has a population of 21,955,334, and this comprises Abia State 3,727347 people, Imo State 5,408,756, Anambra State 5,527,809 people, Enugu State 4,411,119 people while Ebonyi State 2,880,303 people (National Population Commission, 2017). Imo and Anambra are the most populous states of the zone and have a high concentration of economic activities. The South-east states are among the densely settled areas of the country, with an average population density of 247 persons per square kilometer as against the national average of 96 persons per square Kilometer (NPC, 2017). The zone is located at latitudes 5006'N to 6034'N of the Equator and longitudes 6038'E and 8008'E of the Greenwich (Prime) Meridian (Microsoft Corporation, 2009), with a tropical humid climate with two distinct seasons per year: rainy and dry. The rainy season starts in April and ends in March, with regular drops in ambient temperature. The dry season starts in November and ends in March. A hot, dry spell characterizes it. Within the two seasons, the temperature range varies from about 18o C to 34o C. The zone's location within the tropical rainforest belt gives it the ecological essentials for producing a wide range of tropical agricultural products such as rice, yam, oil palm, maize, cassava, and vegetables. Small ruminants, backyard poultry production, and fisheries dominate the livestock industry. The zone's economy primarily depends on agriculture and commerce and the principal occupation of the people is farming.

This study adopted a multistage sampling technique to ascertain the sample frame for the study. In the first stage, the five states in the southeast were purposively selected, namely Enugu, Anambra, Imo, Abia, and Ebonyi States. For the second stage, three agro-ecological zones from each of the chosen States were purposively selected for the study. In the third stage, one Local Government Area (LGA) was chosen from each agro-ecological zone. In the fourth stage, two communities were purposively selected, and in the last stage, five agro farmers were randomly selected from each community, giving a total of 150 farmers. This study used cross-sectional data.

Primary data were collected using well-structured questionnaires administered separately to rural farmers. The instruments were designed to collect information about age, sex, level of education, household size, years of farming experience, income, farm size, and knowledge of agricultural skills. Data collection lasted for four months, between February and May 2024.

Preliminary visits were made to the study area before the commencement of data collection to familiarise the study areas and establish significant relationships and acquaintances with the farmers. A pre-survey of the study was undertaken to test the questionnaire's validity, reliability, and accuracy (data collection instruments). Ten field enumerators were recruited, given adequate

training, and assigned to the study locations, and close monitoring of respondents was carried out to ensure that questionnaires were returned. All the questionnaires distributed to farmers in the 5 South-Eastern States through their respective local government areas were returned 100%. The questionnaire distribution recorded success following the number of field enumerators recruited for the study. See table 1 below:

Table 1: Distribution of questionnaire

STATE/LGA	Distributed		Returned		Unreturned	
	No	%	No	%	No	%
Abia state						
Obingwa	10	6.66	10	6.66	-	-
Umuahia North	10	6.66	10	6.66	-	-
Ohafia	10	6.66	10	6.66	-	-
Imo state		6.66		6.66	-	-
Owerri West	10	6.66	10	6.66	-	-
Orlu	10	6.66	10	6.66	-	-
Isiala-Mbano	10	6.66	10	6.66	-	-
Anambra State		6.66		6.66	-	-
Nnewi North	10	6.66	10	6.66	-	-
Anambra East	10	6.66	10	6.66	-	-
Awka North	10	6.66	10	6.66	-	-
Enugu State		6.66		6.66	-	-
Enugu East	10	6.66	10	6.66	-	-
Nsukka	10	6.66	10	6.66	-	-
Udi	10	6.66	10	6.66	-	-
Ebonyi State		6.66		6.66	-	-
Ezza North	10	6.66	10	6.66	-	-
Abakaliki	10	6.66	10	6.66	-	-
Afikpo South	10	6.66	10	6.66	-	-
Total	**150**	**100.0**	**150**	**100**	**0**	**0**

Source: Field Survey, 2024

5. Data Analysis and Discussions

5.1 Socioeconomic characteristics of farmers according to the Five South-East States in Nigeria

Table 2: Socioeconomic characteristics of farmers according to states

Variable	**Abia State**		**Imo State**		**Anambra State**		**Enugu State**		**Ebonyi State**	
	Fre	%	Fre	%	Fre	%	Fre	%	Fre	%
20-40	12	8.0	10	6.7	11	7.3	9	6.0	11	7.3
41-60	15	10.0	14	9.3	16	10.7	15	10.0	15	10.0
>60	3	2.0	6	4.0	3	2.0	6	4.0	4	2.7
Total	**30**	**20.0**	**30**	**20.0**	**30**	**20.0**	**30**	**20.0**	**30**	**20.0**
Mean age	**42.1**		**43.1**		**44.1**		**45.3**		**43.0**	
Sex										
Male	14	9.3	11	7.3	13	8.7	11	7.3	12	8.0

Female	16	10.7	19	12.7	17	11.3	19	12.7	18	12.0
Total	**30**	**20.0**	**30**	**20.0**	**30**	**20.0**	**30**	**20.0**	**30**	**20.0**
Education level										
Non attended	6	4.0	7	4.7	5	3.3	3	2.0	5	3.3
Primary	10	6.7	5	3.3	12	8.0	7	4.7	19	12.7
Secondary	10	6.7	13	8.7	10	6.7	15	10.0	6	4.0
University	4	2.7	5	3.3	3	2.0	5	3.3	-	-
Total	**30**	**20.0**	**30**	**20.0**	**30**	**20.0**	**30**	**20.0**	**30**	**20.0**
Household size										
1-5	11	7.3	9	6.0	8	5.3	13	8.7	5	3.3
5-10	17	11.3	18	12.0	17	11.3	14	9.3	17	11.3
>10	2	1.3	3	2.0	5	3.3	3	2.0	8	5.3
Total	**30**	**20.0**	**30**	**20.0**	**30**	**20.0**	**30**	**20.0**	**30**	**20.0**
Mean	**7**		**8**		**7**		**5**		**8**	
Scale of farm										
Small Scale	28	18.7	26	17.3	23	15.3	22	14.7	28	18.7
Large scale	2	1.3	4	2.7	7	4.7	8	5.3	2	1.3
Total	**30**	**20.0**	**30**	**20.0**	**30**	**20.0**	**30**	**20.0**	**30**	**20.0**
Years of experience(yrs)										
1-10	6	4.0	2	1.3	7	4.7	3	2.0	10	6.7
10-20	14	9.3	15	10.0	12	8.0	17	11.3	19	12.7
>20	10	6.7	13	8.7	11	7.3	10	6.7	1	0.6
Total	**30**	**20.0**	**30**	**20.0**	**30**	**20.0**	**30**	**20.0**	**30**	**20.0**
Mean	**16.5**		**18.2**		**17.2**		**15.5**		**16.6**	

Source: Field Survey Data, 2024

The result on Table 2 shows that majorities (10%, 9.3%, 10.7%, 10%, and 10%) of farmers in the five South East states under investigation were between the age of 41 and 60 years. There mean ages was between 42 and 45 years per farmer. This implies that farmers in South-eastern states are young, and hence energetic to carry out tedious jobs associated with farming. The result also showed that female farmers dominate among all the respondents interviewed. 16%, 15.3%, 16.7%, 18%, 16.7% of respondents from Abia, Imo, Anambra, Enugu and Ebonyi states respectively had one form of education or another. This implies that majority of the respondents are literate enough to know the benefits of agricultural innovative skills. Majority of the respondents; 11.3% from Abia state, 12% from Imo state, 11.3% from Anambra, 9.3% from Enugu and 11.3% from Ebonyi state had household size of between 5 to 10 persons per household, this shows that farmers in south-east have a fairly large household size. Most of the farmers are into small scale agriculture as represented by the percentage responses from the states. The farmers were well experienced as majority of the respondents across the five states had between 10 to 20 years of farming experience.

5.2 Human capital development skills awareness amongst farmers in South-East, Nigeria

Table 3: Mean rating on human capital development awareness among farmers

S/N	Skills	Mean	Remark
1	Agricultural technology	2.03(0.42)	Disagree
2	Management skills	2.38(0.70)	Disagree
3	Marketing skills	2.64(0.53)	Agree

4	Research and Development	2.39(0.74)	Disagree
5	Environmental awareness	2.32(0.55)	Disagree
6	Communication and interpersonal skills	2.58(0.62)	Agree
7	Extension services	2.20(0.59)	Disagree

Note: Figure in parentheses are standard deviations, n=number of respondents (150).

The result in Table 3 showed that the mean ratings of the responses of the farmers on five items out of the seven items in the table ranged from 2.03 to 2.39 which are in each case less than the cut-off point of 2.50 on the 4-point rating scale. Only two items on the table had means that are greater than the cut-off point. This indicated only the 2 items in the Table are the human capital development known amongst the farmers in Nigeria. Farmers disagree to such human capital skill as agricultural technology (with a mean of 2.03); management skill (with a mean of 2.38); research and development (with a mean of 2.39); environmental awareness (with a mean of 2.32) and extension services (with a mean of 2.20). While they agree to having knowledge of skills such as Marketing skill (with a mean of 2.68) and Communication and interpersonal skills (with a mean of 2.58). This result indicates that the level of human capital development amongst the farmers is very low.

The result shows that skills on Agricultural technology, Management skills, Research and development, Environmental awareness and Extension services were lacking amongst the farmers in South East Nigeria. The implication of this skill gap is that the farmers may struggle to optimize production, leading to lower yields and reduced food availability. This finding corroborated with the submission of this Ndibe (2022), who asserted that concerted efforts are not giving to train rural farmers in Nigeria on the various skills necessary to develop them, improve their level of production and remove them from the vicious level of poverty besieging rural agricultural production. Hence without these skills, the farmers may not be able to contribute effectively towards food production.

5.3. The effect of human capital development on optimal food production in South-East, Nigeria

Table 4: Mean rating on effect of human capital development on optimal food production in South-East, Nigeria

S/N	Relevance of HCD on optimal food production	Mean	Remark
1	Boost knowledge of technology mix in food production	3.73(0.42)	Agree
2	Improves farmers communication skills	3.38(0.70)	Agree
3	Undertake diversified farming practices	3.64(0.53)	Agree
4	Increases farmers access to climate related information	3.39(0.74)	Agree
5	Increases farmers access to farm input supply	3.62(0.55)	Agree
6	They increase overall farmers effectiveness	3.58(0.62)	Agree
7	Improve access to market information	3.20(0.59)	Agree
8	Enables farmers to make contact for farm growth	3.47(0.52)	Agree
9	Enable farmers to utilize the benefits of extension agents	3.57(0.60)	Agree
10	Improves knowledge of cooperative society and benefits	3.65(0.51)	Agree
11	Improves farmers knowledge of best farming practices	3.44(0.57)	Agree

Note: Figure in parentheses are standard deviations, n=number of respondents (150).

The result in Table 4 showed that the mean ratings of the responses of the farmers on the eleven items in the table ranged from 3.20 to 3.78 which are in each case greater than the cut-off point of 2.50 on the 4-point rating scale. This indicated that the 11 items in the Table are the relevance of Human capital development for optimal food production in Nigeria. Investing on human capital development such as technical skill, management, research and extension skills equip the farmers to engage in multiple farming activities and enhanced farming practices which invariably will improve the productivity levels in the farm (Ndibe, 2022). This finding corroborated with the submission of Nowak and Kijek (2016) that human capital development has a positive effect on the average and marginal productivity of the farms. Kainga, *et al.,* (2016) reported that knowledge and access to extension has a significantly relationship with human capital development.

5.4 The effect of Human Capital Development on Food Security in South-East, Nigeria

Table 4: Regression result on the effect of human capital development on food security

Variable	Linear	Exponential+	Double-log	Semi-log
Constant	867.788	10.019	2.213	109378.497
	(8.399) ***	(7.409) ***	(4.344)***	(7.656)***
Agricultural technology	12.037	0.152	1.026	4210.088
	(0.698)	(0.931)***	(2.485)	(0.007)
Management skills	29.712	0.028	-0.3609	-3623.337
	(1.121)	(2.865)***	(-5.492)***	(-1.931)*
Marketing skills	165.938	0.353	0.619	1309.409
	(3.656)**	(6.062)	(2.382)**	(6.410)***
Research and Development	211.005	0.119	-0.016	-1010.082
	(1.466)	(7.419)***	(-1.188)	(-3.106)***
Environmental awareness	32.517	6.681	0.136	1035.101
	(2.184)**	(3.745)***	(3.261)***	(4.591)***
Communication and	21.434	0.005	-0.009	1311.971
interpersonal skills	(1.138)	(0.972)	(-0.818)	(0.821)
Extension services	-18.287	0.302	-0.125	-2234.530
	(-5.216)***	(3.365)***	(-3.336)***	(-0.427)
R^2	0.878	0.960	0.943	0.914
Adj. R^2	0.851	0.946	0.924	0.890
F-statistic	75.160***	76.406***	82.348***	74.116***

***significant at 1%; ** significant at 5% and *significant at 10%. + = means lead equation. Values in parenthesis are t- ratio.

The exponential function was chosen as the lead equation based on the values of the coefficient of multiple determination (R2), F-statistics, the number of significant variables, and the signs on the variables as they conform to a priori expectations. The result in Table 4 showed that the coefficient of multiple determinations (R2) is 0.960, which implies that about 96% of the variability in food security for farmers in Nigeria is caused by the specified explanatory variables. The results show that determinants of human capital development such as Agricultural technology, Management skills, Research and Development, Environmental awareness, and Extension services significantly affect food security.

The coefficients of agricultural technology (0.152), Management skills (0.028), Research and Development (0.119), Environmental awareness (6.681), and Extension services (0.302) were positively signed and significant at a 1% level. The positive sign of these variables indicates that if there is an increase in these variables, then there will be an increase in the food security of the farmers in the study area. Agricultural technology was positive and significantly related to food security, implying that as more household heads are exposed to agricultural technology, the more food secure the household becomes. This conforms with a priori expectations. This is because technology enhances production levels with minimal cost of inputs (Ebe et al., 2020). Similarly, management skills positively affect food security; this implies that farmers with management skills can make good decisions related to utilizing scarce resources available for production. Management skill is an important factor of production required to improve a firm's overall output (Olukosi & Erhabor, 2021). Research and development have a positive sign and effect on food security, an implication that as farmers engage deeper in Research and development on agriculture, they will be able to develop new methods that are beneficial for increased output, hence ensuring their food security; this finding corroborates with the work of Nwachukwu (2020). Environmental awareness skill is significantly related to food security, which implies that as farmers become more conscious and aware of environmental changes, their level of food security increases. Extension services have a positive relationship with food security. The implication of this is that as farmers become more acquainted with the services of extension agents, they develop better skills and adopt technologies necessary to improve the level of farm production and hence improve the level of food security in their households (Edna et al., 2007).

6. Conclusion

Attaining sustainable national food security is an integrated approach that aligns with global development agendas such as SDG 2 – Zero Hunger and supports national strategies for achieving sustainable food systems in Nigeria. This study examines the Effect of Human Capital Development on Food Security in South-East, Nigeria and aims to bridge the Skills Gap in Agro-Industry. The study revealed that human capital development influences optimal food production by boosting the farmer's knowledge of the technology mix in food production, improving farmers' communication skills, equipping farmers to diversify farming practices, increasing farmers' access to climate-related information, improving access to market information, equip farmers to make contact for farm growth, enable farmers to utilize the benefits of extension agents and Improving farmers knowledge of best farming practices. Agricultural technology, management skills, Research and development, environmental awareness, and extension services have a positive and significant effect on food security, which implies that a unit increase in their skill level will increase the level of food security by 1 percent. Farmers were unaware and did not possess agricultural skills such as agricultural technology, management skills, Research and development, environmental awareness, and extension services. This skills gap in Nigerian agriculture is a critical factor impeding food security in the country, as the inability to adopt modern farming techniques, manage resources efficiently, embrace technological innovations, and have access to extension services has left Nigeria unable to meet its food needs, resulting in increased food insecurity.

7. Recommendations

The following recommendations were made to serve as policy options for Nigerian government in achieving food security through bridging skill gaps in the Agro-industry.

i. **Revamp Agricultural Education and Curriculum Alignment:** Agricultural education in Nigeria must be reformed to align with current industry needs. This includes integrating practical, hands-on training in secondary schools, colleges of agriculture, and universities with a curriculum emphasizing agricultural technology, agribusiness management, sustainability, and digital innovation in farming. Human capital development interventions such as training programs, capacity building, and collaboration between industry stakeholders, educational institutions, and government agencies should be given a concerted effort. The government should create mechanisms that will facilitate an improvement in the level of education among the farming population on basic knowledge of agricultural technology, improved management practices, and weather and environmental conditions.

ii. **Strengthen Extension Services and Field-Based Learning:** Agricultural extension officers well-versed in modern technologies and sustainable practices should be massively recruited, trained, and deployed. These officers should serve as community-based facilitators for continuous learning, helping farmers adopt innovations and troubleshoot production challenges.

iii. **Institutionalize Farmer Mentorship and Peer Learning Models.** Experienced farmers and agripreneurs should constantly mentor younger and less experienced farmers. Mentorship models will build trust and underpin practical skills and innovation adoption within farming communities.

iv. **Establish Agricultural Skills Development Centers in Rural Areas.** Collaborating with NGOs and private sector actors, the government should establish dedicated agricultural skills acquisition and development centers in rural communities. These centers should equip farmers with modern agricultural practices, including climate-smart agriculture, post-harvest handling, precision farming, and digital aggrotech skills.

v. **Leverage Digital Platforms and E-Learning for Farmer Training.** Local Technology Network platforms in local languages should be scaled up for rural farmers. Digital training can inform access to diverse education with broader outreach. Centralized platforms with real-time features should enhance market and climate information systems.

vi. **Enhance Farmers' Access to Market and Climate Information Systems.** Develop centralized platforms that provide real-time access to weather forecasts, price updates, input suppliers, and buyer networks. Such access will support informed decision-making, minimize losses, and improve productivity across the value chain.

vii. **Strengthen Policy Support for Human Capital Development in Agriculture.** Government policies must prioritize and fund human capital development as a core pillar

of agricultural transformation strategies. This includes increasing Agricultural education funding, R&D, and strategic collaborations.

viii. **Monitor and Evaluate Skills Development Impact on Food Security.** Launch structures to trail and consider human capital development initiatives impact on food security indicators to bring about accountability, upgrade designs, and monitor data-driven decision-making

ix. **Agricultural education funding, R & D, and strategic collaborations.** Monitor and Evaluate Skills Development Impact on Food Security. Launch structures to trail and consider human capital development initiatives impact on food security indicators to bring about accountability, upgrade designs, and monitor data-driven decision-making. The federal government should provide R&D facilities across the various states to help farmers access dynamic and innovative information on new ways of improving agricultural productivity and enhancing Nigeria's current food output.

x. **Promote Public-Private Partnerships (PPPs) in Agro-Skills Training.** Suppose stakeholders, developmental partners, and donors are motivated to fund and implement capacity-building programs for smallholder farmers. In that case, training content will be valuable, technology more accessible, and the food and nutrition needs of the people market will be met.

xi. **Integrate Women and Youth in Targeted Agro-Skills Programs.** Given the demographic relevance of women and youth in agriculture, gender-sensitive and youth-focused training programs should be developed. These programs should address barriers to access, provide mentorship, and facilitate entry into value-added agro-enterprises

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