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Socioeconomic status, psychological well-being, and the technical efficiency of small-scale poultry farmers in Nigeria

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ABSTRACT

This study investigated the interplay between the MacArthur Subjective Socioeconomic Status (SSS), Ryff's Psychological Well-Being (PWB), and Technical Efficiency (TE) among small-scale broiler farmers in Southwest Nigeria. Using a multistage procedure, 323 respondents were randomly selected. The analysis revealed significant relationships between variables, with broilers per production cycle and feed intake positively impacting output. Temperature volatility had a negative effect on output due to increased stress in broilers. Age and cooperative membership were key factors influencing TE. The study also examined how subjective SES and PWB influenced innovative practices and risk-taking, ultimately enhancing TE. The incorporation of Ryff's PWB highlighted the positive impact of psychological well-being on TE through autonomy, personal growth, and purpose. Context-specific strategies and inclusive assessments are recommended to optimize technical efficiency in broiler farming, focusing on psychological well-being and subjective perceptions.

Keywords: Socioeconomic Status, Psychological Well-Being, Technical Efficiency, Poultry, Volatile temperature conditions.

1. INTRODUCTION

Broiler chickens are vital domesticated birds that provide meat for people worldwide. According to a 2023 report by the United Nations Food and Agriculture Organization, poultry is the most consumed type of meat. In 2019, the average worldwide poultry consumption per person was 14.8 kg. It is favourably considered for economic and health reasons. Studies have shown that a diet rich in protein and essential nutrients positively affects birth weight, growth, and cognitive development and decreases child mortality rates (Blackie, 2014). Animal protein consumption is also associated with the income of rural households. Furthermore, the prospects and socioeconomic contributions of poultry production in developing economies are highlighted by (Erdaw and Beyene, 2022). Their study emphasized the importance of eggs and poultry meat as sources of crucial nutrients such as protein, minerals, and vitamins.

The global demand for chicken meat is anticipated to increase, particularly in developing nations (Mottet and Tempio, 2017). In response to this heightened demand, production methods have been intensified to maximise efficiency and productivity, sometimes compromising the well-being and health of chickens (Azarpajouh et al., 2022). In sub-Saharan Africa (SSA), chicken meat is recognised as a highly affordable source of animal protein (Butterworth, 2017). The region is experiencing notable population growth, as highlighted by the UN World Population Prospects in 2019 UN, (2019) and research by (Samboko et al., 2018). However, the slow and inconsistent economic growth in SSA has led to a rise in poverty levels among its population (Erdaw and Beyene, 2022; Pinstrup-Andersen and Rosegrant, 2001).

There is evidence that three in every ten poor people in the world live in Sub-Saharan Africa (Erdaw and Beyene, 2022; Pinstrup-Andersen and Rosegran, 2001). The 2023 Global Hunger Index reports a score of 28.3 for Nigeria. Significantly, Nigeria has experienced a consistent rise in undernourishment since 2015. Economic recessions in Nigeria have underscored the need for strategic income diversification to improve well-being and sustain livelihoods. Farmers must enhance efficiency to increase output and income. High inflation, at 33.7% in 2024 CBN, (2024), has reduced purchasing power and increased poverty, prompting many people, particularly young people and women, to engage in poultry production to improve their income and enhance their well-being (Iliya et al., 2024). Additionally, poultry production is acknowledged as a fast and effective method for rapidly increasing the availability of animal protein to close the nutrient gap and sustain the agrifood system in the subregion (Nwobodo et al., 2023).

According to the Global Agricultural Information Network, beginning in 2024, the production of chickens in Sub-Saharan Africa is expected to experience steady growth. This growth can be attributed to the development of an increasingly vertically integrated industry that will take advantage of lower feed prices resulting from a strong production of maize and soy. To ensure the sustainability of the subregion's agrifood system, researchers have been investigating a range of potential strategies. The adverse effects of climate change on poultry production have been highlighted by the (FAO, 2018). Improving the environmental sustainability of poultry production is crucial for increasing productivity, as emphasised by (Leinonen and Kyriazakis, 2016). Alice, (2016) identified economic and population growth as primary drivers of chicken consumption in Sub-Saharan Africa (SSA). This suggests that with the expansion of the economy and an increase in population, chicken consumption is expected to increase as well.

Therefore, the projected growth of chicken production in Sub-Saharan Africa presents opportunities for enhancing the agrifood system. To fully harness the potential of the industry in developing economies, it is crucial to address the hurdles brought about by climate change (specifically temperature fluctuations), enhance socioeconomic and environmental sustainability, and promote the psychological well-being of broiler farmers. This is important because of the socioeconomic contributions and nutritional benefits of poultry production, among other benefits (FAO, 2018; Leinonen and Kyriazakis, 2016; Alice, 2016; Blackie, 2014; Erdaw and Beyene, 2022). In Nigeria, the FMA&RD forecast for poultry meat production and demand in 2019 estimated a national output of 551,000 metric tons (MT) and a demand of 1,080,000 MT, resulting in a supply deficit of 529,000 MT.

Growth in population and an improved economy are two major drivers that will influence demand for chickens in the future; however, there is a general concern that the current production pattern will be able to produce enough chicken meat to meet the growing demand in Nigeria. This is a result of the low productivity of broiler production in Nigeria (Bethel et al., 2016; Adesehinwa et al., 2016). In view of the increasing input costs and limited opportunities for expanding farm size laterally, farmers are anticipated to enhance their resource use efficiency to optimise their outputs. Poultry meat comprises approximately 33% of global meat production FAOSTAT, (2023), highlighting its importance. However, poultry birds are highly sensitive to weather conditions, with recent climate changes causing significant mortality (World Bank Group, 2023).

Environmental factors such as rainfall, temperature, relative humidity, and sunshine critically affect poultry performance. Poor housing, ventilation, and management practices also negatively impact poultry farming. High temperatures and humidity decrease feed efficiency and body weight, while variable rainfall increases mortality and reduces productivity and egg quality (Zhang et al., 2023). This study aimed to evaluate the relationships among socioeconomic status, psychological well-being, and the technical efficiency of poultry farmers. The remainder of this paper is organised as follows: Section 2 covers the literature review, Section 3 outlines the methodology, Section 4 presents the results and discussion, and Section 5 provides the conclusion and recommendations.

2. LITERATURE REVIEW

Conceptual Framework

Socioeconomic Status (Objective & Subjective) and Poultry Farmers' Technical Efficiency

Objective socioeconomic status (SES), as described by many authors, suggests access to material and social resources (Oakes and Rossi, 2003; Snibbe and Markus, 2005). According to past studies, objective socioeconomic status (SES) is commonly measured using indicators such as income, educational level, and occupation, which reflect differences in individuals' access to these resources (Lucas and Schimmack, 2009; Kraus et al., 2012). Income is an important component of objective SES, as it allows individuals to obtain desired services, goods, and experiences. It has been found to be associated with psychological variables such as social trust and prosocial behaviour (Lucas and Schimmack, 2009; Kraus et al., 2013). Education serves as a marker for sociocultural and psychosocial outcomes and is linked to economic advantages, such as reduced financial hardship American Psychological Association, (2007) and improved technical efficiency of poultry production (Bethel et al., 2016).

As a proxy for objective SES, occupation is closely connected to income and education, and it also influences individuals' psychological experiences (Duncan and Magnuson, 2012; American Psychological Association, 2007; Kraus et al., 2013). While objective SES is typically measured using global indices in research, there is growing recognition of the role of subjective assessments based on social comparisons. Subjective SES refers to individuals' perceptions of their position in the social hierarchy relative to others. The MacArthur SSS is a widely used tool to assess subjective SES (Adler et al., 2000; Kraus et al., 2013). Unlike objective SES, subjective SES captures individuals' perceptions of their standing, which may not always align with their actual material resources.

Recent studies have shown distinct associations between subjective SES measures, such as the MacArthur SSS scale, and traditional objective SES indicators, highlighting the conceptual and empirical differences between the two (Jury et al., 2019; Loeb and Hurd, 2019; Bjornsdottir et al., 2017; Wang et al., 2019). Intuitively, individuals' perceptions of their social hierarchy relative to others in the industry carry some responsibilities to competently perform their role as entrepreneurs, such as producers of broiler chickens. However, there is no evidence of the effect of subjective SES on the technical efficiency of farmers. The literature debate regarding the relationship between the MacArthur SSS (subjective SES) and both objectives is inconclusive. The subdomains across the variables are related differently, as evidenced in the works of (Navarro-Carillo et al., 2020; Destin et al., 2017; Huang et al., 2017).

Institutional Factors

Bethel et al., (2016) suggested that institutional factors, such as access to credit, membership in cooperative associations, and access to extension services, lead to a reduction in technical inefficiency. In other words, a favourable institutional framework enhances the performance (technical efficiency) of entrepreneurs. In this study, poultry farmers were considered entrepreneurs.

Psychological wellbeing

Several psychosocial factors are known to contribute to distress and suicide risk among male farmers (Woolford et al., 2022). Many male farmers exhibit traits such as stoicism, self-reliance, and emotional suppression Rickwood et al., (2012), defining health primarily in terms of productivity (Bourke et al., 2012). Additionally, research has shown that male farmers often adhere to unsustainable work ethics Brew et al., (2016), experience heightened isolation and face significant pressure to conform to traditional gender roles (Perceval et al., 2018). Agricultural work environments can also be challenging. According to Woolford et al. (2022) and Alston & Kent (2008), factors such as risk-taking behaviours increase the risk of physical illness, which affects production expectations Gunasekera et al., (2007) and has the potential to contribute to harmful outcomes.

The discussion above illustrates how the psychological well-being of farmers concurrently impacts both their objective and subjective socioeconomic status (Navarro-Carrillo et al., 2020). The adaptation of Ryff's Psychological Well-Being Scales into Spanish is elaborated below based on the research conducted by (Navarro-Carrillo et al., 2020). The psychological well-being (PWB) domain comprises several major subscales, each addressing fundamental aspects of an individual's mental and emotional health. Autonomy (A), as one of these subscales, refers to a deep sense of independence, self-determination, and personal agency. It involves the perception of having control over one's actions, decisions, and life choices, which are essential for a feeling of empowerment and well-being. Another crucial subscale within the PWB domain is Environmental Mastery (EM). This subscale relates to an individual's capability to effectively manage and adapt to their environment. It encompasses feeling competent, capable, and skilled at dealing with the challenges and opportunities presented by one's surroundings, thereby nurturing a sense of confidence and resilience.

Personal growth (PG) is also a significant component of psychological well-being. It involves the ongoing process of development and self-improvement. This subscale reflects an individual's dedication to learning, growth, and striving for personal excellence, contributing significantly to a sense of fulfilment and purpose in life. Positive Relations (PR), as a subscale, focuses on the quality of an individual's social connections and relationships. It emphasises the importance of having fulfilling, supportive, and meaningful interactions with others, such as family, friends, and community members. Strong positive relations contribute to emotional well-being and overall life satisfaction. Purpose in Life (P) is a vital aspect of psychological well-being that involves a sense of meaning, direction, and significance in life. It involves feeling motivated by meaningful goals, values, and a sense of purpose that provides fulfilment and direction in life.

Self-acceptance (SA) reflects an individual's ability to have a positive and realistic view of oneself. It encompasses self-confidence, self-respect, and self-compassion, allowing individuals to accept both their strengths and weaknesses without harsh self-judgement. Self-acceptance is foundational to psychological well-being because it fosters a sense of inner peace and self-contentment. Figure 1 depicts the conceptual model that links farmers' objective and subjective socioeconomic status, institutional factors, and psychological well-being to their technical efficiency. The correlation (r) between farmers' objective and subjective socioeconomic status was examined, and due to their strong correlation, the income, education, and occupation subscales in objective SES were omitted in favour of similar subscales in subjective SES to establish the model for the technical efficiency of broiler farmers. Ultimately, every broiler producer aims to achieve an optimal level of production with maximum output (yield) using minimal resources (efficiency).

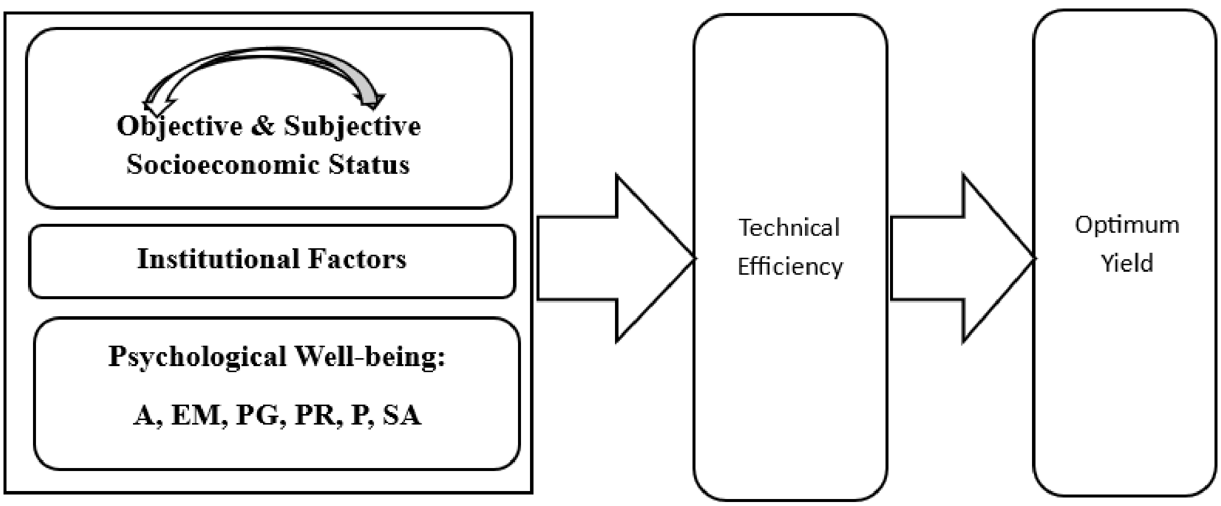

Figure 1 Conceptual Model Connecting Farmers' Objective and Subjective Socioeconomic Status, Institutional Factors and Psychological Well-being to Their Technical Efficiency.

Theoretical Literature

The evaluation of technical efficiency in agriculture, especially concerning both output-oriented and input-oriented approaches, provides a nuanced comprehension of farm productivity and resource utilisation. A critical theoretical review of the selected literature provides insights into the methodologies used and their relevance to different farming contexts. Farm efficiency is assessed using both output-oriented and input-oriented methods. The output-oriented approach evaluates how much additional output a farm can generate with its existing inputs. This type of efficiency reflects a farm's productivity compared to optimal farm management practices and is suitable for farms capable of increasing their output, such as many poultry farms in the study area with greater revenue potential.

Conversely, the input-oriented approach investigates how a farm can maintain the same output level while using fewer resources. Here, efficiency is viewed as the farm's resource use in relation to best practices. This method is more appropriate for farms that cannot easily alter their output levels but can adjust their input usage, often due to budget constraints. This study utilises the stochastic frontier production function to estimate the technical efficiency of small-scale poultry farming. Technical efficiency gauges how close a production unit's output is to its optimal level, given the inputs used. This is typically expressed as the ratio of observed output to maximum potential output. If a farm is not achieving the maximum possible output from its inputs, it is deemed technically inefficient, indicating excessive input use.

Historical and Theoretical Context

The concept of production efficiency was introduced by Farrell, (1957), who illustrated it using two inputs to produce one output. In his model, the unit isoquant represents the frontier of efficient production. The technical efficiency (TE) of a farm can be quantified by comparing its position relative to this frontier. If a farm utilises inputs at point P to generate output, its technical inefficiency is the distance from P to the isoquant, representing the potential reduction in inputs without affecting output (Figure 2). This inefficiency is expressed as the ratio QP/OP, with technical efficiency measured by 1 - QP/OP, ranging from zero (fully inefficient) to one (fully efficient).

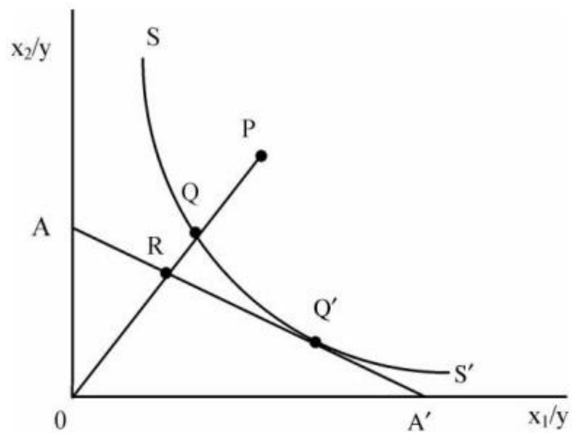

Figure 2 Farrel Efficiency Measure

Farrell's ideas were expanded upon in subsequent works by Aigner et al., (1977), Battese and Corra, (1977), Meeusen and Van-den-Broeck, (1977), and Ajibefun et al., (2006), who contributed to estimating frontier production functions. These functions represent the maximum output achievable from specific inputs, taking into account potential technical inefficiencies.

Stochastic Frontier Production Function

The stochastic frontier production function models the relationship between inputs and outputs while accounting for inefficiency and random errors. The function is defined as:

$Yi=f(Xi,\beta)\exp(Vi-Ui)$………………………………………………………. (1)

where Yi is the output of the ith farmer, Xi represents the input variables, β represents the production coefficients, Vi is a random error, and Ui is the inefficiency term. The output Yi is bounded by the stochastic frontier f(Xi,β)exp(Vi), incorporating both random variations and inefficiencies. The random error Vi follows a normal distribution, while Ui is a nonnegative term representing inefficiency and is often modelled as a truncated normal distribution. The total error term $\epsilon i=Vi-Ui$ combines these components, each governed by distinct distribution assumptions.

Factors Influencing Technical Efficiency

The productivity of individual farms in relation to the efficiency frontier is influenced by various factors, such as farm size, tenure, specialisation, mechanisation, operator characteristics, geographical location, management practices, and organizational structure. These elements affect the efficiency with which farms convert inputs into outputs.

Application in the Context of this Study

In the context of small-scale poultry farming in Nigeria, understanding technical efficiency involves analysing how well farmers utilise their inputs to achieve optimal output levels. This study adopts the Battese and Coelli, (1995) distribution assumption for the inefficiency term, reflecting the practicalities of Nigerian agricultural conditions. By identifying inefficiencies and their sources, interventions can be designed to improve productivity and sustainability in this sector. In this study, it is hypothesised that the technical efficiency of small-scale poultry farmers in Nigeria is influenced by a myriad of factors, including socioeconomic status (SES) and psychological well-being (PWB). Understanding these dimensions is crucial for enhancing productivity and sustainability within this sector. SES encompasses income, education, and social standing, which significantly impact the technical efficiency of farmers.

A higher SES often correlates with better access to resources, information, and technology, which can improve farming practices and efficiency. According to Van-Eerdewijk and Danielsen, (2015), farmers with higher SES are more likely to adopt innovative techniques and practices, leading to enhanced productivity and efficiency. Conversely, lower SES can limit access to essential resources, hindering farmers' ability to optimise their input use and production processes. PWB is another critical factor influencing technical efficiency. PWB includes aspects such as mental health, stress levels, and overall life satisfaction. Research by Diener and Seligman, (2004) indicates that greater psychological well-being can enhance cognitive function and decision-making capabilities, which are vital for efficient farm management. Farmers experiencing poor psychological well-being may struggle with stress and anxiety, potentially leading to suboptimal decisions and reduced efficiency.

A study by Wilton, (2019) and Pinstrup-Andersen and Rosegran, (2001) emphasised the importance of mental health support for farmers, noting that improved psychological well-being can lead to better farm management and productivity. The interaction between socioeconomic status and psychological well-being further complicates their impact on technical efficiency. Lower socioeconomic status often correlates with higher stress levels and poorer mental health, intensifying the challenges farmers face. Wilkinson and Pickett, (2010) highlight this intersection, demonstrating that socioeconomic disparities can lead to significant psychological stress, which adversely affects productivity.

Empirical Review

According to Farrell, (1957), farm efficiency is the capacity of a farm to generate optimal output using available inputs. Farrell introduced the empirical measurement of technical efficiency (TE) using a nonparametric frontier approach, setting the stage for "Farrell efficiency measurement". This method assumes that the fully efficient production function is known, which is then estimated from sample data using either nonparametric or parametric methods such as the Cobb-Douglas function. Employed a deterministic parametric frontier with the Cobb-Douglas function, while advanced this by introducing a probabilistic frontier. Various empirical studies on the efficiency of poultry systems have shown that inefficiency determinants are influenced by two main factors. The first set of factors relates to farmer characteristics, including demographics (such as age), education, and experience, as examined by (Yenibehit et al., 2019; Ullah et al., 2019; Oleke and Isinika, 2011).

The second set involves institutional factors, specifically access to credit and extension services, explored by (Yenibehit et al., 2019; Ullah et al., 2019; Bethel et al., 2016). These studies highlight the significance of both farmer characteristics and institutional factors in determining the efficiency of poultry systems. Additionally, other findings in this study highlight the impacts of Ryff Psychological Well-being Scales on the technical efficiency of entrepreneurs, including poultry farmers. Gupta and Jena, (2024) explore how entrepreneurial ventures can reduce friction and increase efficiency through the implementation of spiritual self-managed teams and a holacracy. Their findings suggest that holacracy, which emphasises autonomy and empowerment, can significantly enhance decision-making capabilities and reduce inefficiencies. This aligns with the observed reduction in technical inefficiency among autonomous poultry farmers.

By allowing individuals more control over their work and reducing external constraints, holacracy fosters a sense of empowerment and better resource management, mirroring the benefits of increased autonomy among farmers. Antonio et al., (2024) explore how entrepreneurial ventures can innovate value propositions to make their technologies more appealing. They highlight that enhancing adventure capabilities, including granting more autonomy to team members, can improve the attractiveness and effectiveness of these offerings. The study underscores the importance of autonomy in entrepreneurial ventures, suggesting that increased control and freedom for individuals promote innovation and efficient resource management. This is directly relevant to findings that greater autonomy among poultry farmers reduces technical inefficiency, implying that autonomy fosters better decision-making and resource utilisation.

Goldin, (2024) examines the role of human capital in economic growth throughout the twentieth century, emphasising that the accumulation of human capital through education and skill development has been a crucial driver of economic efficiency and productivity. This aligns with the finding that personal growth reduces technical inefficiency among farmers. Continuous education and development enhance farmers' skills and knowledge, enabling more effective resource use. This supports the notion that investing in farmers' personal growth through educational programs and skill development can lead to significant improvements in technical efficiency. Papanek, (2024) explored the efficiency of development programs in Pakistan, highlighting the importance of technical education and training. He noted that the availability of raw materials and spare parts, combined with technical education, significantly improved industrial capacity and efficiency. This underscores the value of continuous learning and development in enhancing resource management and operational efficiency.

The study suggests that technical education and ongoing development opportunities are crucial for improving efficiency, which resonates with the finding that personal growth among farmers reduces technical inefficiency. By providing continuous education and development opportunities, policymakers can create an environment where farmers are better equipped to manage their resources efficiently and improve overall productivity. Khefacha et al., (2024) examine how entrepreneurial aspirations, including goals of high growth, innovation, and internationalisation, contribute to prosperity. The study highlights that clear and ambitious objectives can drive individuals to achieve higher levels of efficiency and success in their ventures. This aligns with the finding that a strong sense of purpose reduces technical inefficiency among farmers. Just as entrepreneurial aspirations lead to focused and goal-driven actions that enhance prosperity, farmers with a clear sense of purpose are likely to be more efficient in managing their operations.

The study suggests that setting clear and ambitious goals can be a critical factor in improving performance and efficiency, which can be directly applied to agricultural policies aimed at enhancing farmers' productivity. Hamid et al., (2024) explore how social media can influence trust, self-perceived creativity, and satisfaction among millennial entrepreneurs. This study emphasises that having a platform to share goals and achievements can enhance motivation and focus. This relates to the idea that a strong sense of purpose can reduce technical inefficiency. By fostering a sense of direction and purpose, social media helps entrepreneurs stay motivated and engaged, which in turn improves their efficiency. Similarly, farmers who have platforms to share their goals and progress may feel more motivated and focused, leading to better management of their resources. Policies that support goal setting and achievement through community engagement and technology can thus enhance efficiency.

Gap in Literature

Evidence in the literature reveals that psychological well-being enhances human functioning (Kállay and Rus, 2014). For farmers, this can translate to the efficient utilisation of input resources to achieve optimum output. However, the impact of poultry farmers' psychological well-being on their technical efficiency has not been explored. Additionally, Galvan et al., (2023) argued for separating economic circumstances and social status when predicting health outcomes. Navarro-Carrillo et al., (2020) supported this perspective, demonstrating that the MacArthur ladder of socioeconomic status, which provides a comprehensive measure of economic circumstances, predicts health and welfare more effectively than individual metrics such as income or educational attainment. Nevertheless, no research has examined the impact of the MacArthur ladder of socioeconomic status on farmers' technical efficiency.

There are several compelling reasons to replace objective SES with subjective SES as a factor influencing technical efficiency. One key intuition is recognising the influence of individual perceptions and experiences on behaviour and decision-making. Subjective SES captures how individuals view their own socioeconomic status relative to others, which can influence their motivation, confidence, and strategic choices. This perception, combined with psychological factors such as self-esteem and perceived control over resources, can drive farmers towards innovative practices, risk-taking, and investment in productivity, ultimately enhancing technical efficiency. These findings corroborate the arguments of (Galvan et al., 2023; Navarro-Carrillo et al., 2020). Moreover, the MacArthur SSS (subjective SES) provides a deeper understanding of contextual nuances, including social networks, cultural beliefs, and local dynamics, which play pivotal roles in farmer decision-making.

This approach aligns with the need for context-specific strategies in diverse agricultural landscapes, promoting more adaptable and inclusive assessments of socioeconomic influences on farming productivity (Navarro-Carrillo et al., 2020). This study is significant not only because it opens a new path for debate on the determinants of technical efficiency but also because recommendations from this study will increase policy options available to policymakers to improve the performance of broiler farmers in Nigeria and other countries in SSA. Poultry farmers in developing economies such as Nigeria face significant challenges in achieving high production levels with limited resources, partly due to poor psychological well-being. Khan et al., (2022) suggested that optimising the technical efficiency (TE) of poultry business operations is a promising strategic approach. Farmers need to be healthy to be efficient, and any policy strategy aimed at achieving this is a worthy effort.

Apalowo et al., (2024) investigated the impact of heat stress on poultry birds, attracting the interest of scholars studying the specific factors associated with heat stress and poultry production. However, there is limited research on how heat stress affects poultry production in Nigeria, which this study aims to address. According to Mitchell and Kettlewell, (1998), the level of heat stress in poultry can be assessed by monitoring variations in their core body temperature. Moderate heat stress is characterised by an increase of 0.4°C to 1°C in core body temperature, while severe heat stress is defined by an increase of more than 1°C. High temperatures affect poultry by triggering the hypothalamic-pituitary-adrenal (HPA) axis, leading to elevated corticosterone levels (Mitchell and Kettlewell, 1998; Garriga et al., 2006; Star et al., 2008).

3. METHODOLOGY

Study area, sample size, and sampling technique

The study was conducted in the Southwest region of Nigeria, which has a high density of commercial poultry farms primarily focusing on broiler and layer chicken production for meat and eggs, respectively. Smallholder chicken farming is a predominant activity, providing a major source of income for many in the area. This region is geographically located between latitude 6°N and 4°S and longitude 4°W and 6°E, covering a land area of 114,271 km², which represents 12% of the country's total land mass. It consists of six states: Ekiti, Lagos, Ogun, Ondo, Osun, and Oyo. According to the Federal Ministry of Agriculture & Natural Resources FMA&NR, (1997), the region has a typical equatorial climate characterised by distinct dry and wet seasons. The main growing season lasts up to nine months, with peak periods in July and September. Rainfall varies across the region, ranging from 2600 mm in the coastal areas of Lagos and Ogun States to nearly 1200 mm in the northern areas of Ondo, Oyo, and Osun States.

On average, the region receives 1480 mm of rainfall. Temperature ranges from 18°C to 24°C during the rainy season and 30°C to 35°C during the dry season. Livestock production is also prominent in the region, with goats, sheep, cattle, pigs, and poultry being the main livestock species. A multisampling approach was used to select respondents for this study, and the same technique was employed for the broiler farms. In the initial stage, the Southwest Zone was chosen due to the prevalence of smallholder chicken farming in this area. In the second stage, three states within the zone were randomly selected (Ogun, Oyo, and Ondo States). In the third stage, four local government areas (LGAs) were randomly chosen from each state. The decision to choose LGAs instead of agricultural development project (ADP) zones was based on the organisation level of the Poultry Farmers' Association of Nigeria (PFAN), which was more structured at the LGA level compared to the ADP zone level.

In the final stage, the ADP and Ministry of Agriculture in each state collaborated with the local government chapters of the PFAN to obtain the list of smallholder broiler chicken farmers in each selected LGA. Following the categorisation in Adesehinwa et al., (2016), small-scale broiler chicken farmers were classified as farmers with stock sizes ranging from 20 to 1,000 birds on their farms. As the study could not ascertain the exact population of all smallholder broiler chickens in the zone, the research adopted Cochran's formula for computing the sample size for an unknown population, as outlined in equation 2 (Cochran, 1977), following the methods of (Khan et al., 2022; Kukoyi et al., 2022).

$$n = \frac{z^2 * p(1-p)}{d^2} \quad \text{.........} (2)$$

where n = minimum sample size; z = constant at 95% confidence interval, which is 1.96 for a two-tailed study; p = best estimate of population prevalence of 50% (but this study adopts 30% because of convenience of the data collection); and d = precision, which is at 95% confidence interval of 5%. This approach yielded a total of 323 samples of poultry farmers (from the environmental control shed system) in the subregion. From each list obtained from the PFAN in each LGA, respondents were randomly selected through a proportional allocation sampling technique, as shown in equation 3:

$$n_i = n^* \left(\frac{N_i}{N}\right) \quad \text{.........} (3)$$

where

n_i = Number of sampled respondents in each LGA;

n^* = Total sample size of respondents (broiler chicken farmers);
Ni = Total number of broiler chicken producers in each LGA;
N = Total number of broiler chicken producers listed in the PFAN register in the study area.
The data set of this study, therefore, comprises 323 broiler chicken producers in Southwest Nigeria, where producers employed an environmental control shed system.

Theoretical Framework

The Cobb Douglas production function provides the theoretical underpinnings for this study on the basis of showing the relationship between output and input. The CD function assumes constant returns to scale and unitary elasticity of substitution.
For two variable inputs, the function can be expressed as:

$Y = AL^{b_1}K^{b_2}e$………………………………………………………..(4)

In the equation, where Y represents the level of output, L and K are the variable inputs, A is a constant factor, b1 and b2 are the coefficients of L and K, respectively, representing the elasticity of the factors, and e is the error term. The sum of b1 and b2 indicates the nature of returns to scale. According to Upton, (1979) and Terfa and Terwase, (2011), the Cobb–Douglas production function cannot capture both increasing and diminishing marginal productivity in a single response curve. Therefore, it fails to provide a technical optimum. Despite its drawbacks, researchers still find the Cobb–Douglas production function valuable when analysing surveys involving multiple variable inputs and when it is necessary to measure returns to scale, factor intensity, and overall production efficiency.

Additionally, it can be used to obtain coefficients for testing hypotheses (Cobb and Douglas, 1928; Terfa and Terwase, 2011). Erdaw and Beyene, (2022), Bethel et al., (2016) and Terfa and Terwase, (2011) argue that the Cobb–Douglas production function is superior to other forms of production functions because it better satisfies the economic, statistical, and econometric criteria of many studies. The literature discusses two approaches for assessing technical efficiency: data envelopment analysis (DEA) and stochastic frontier analysis (SFA). Erdaw and Beyene, (2022) highlight a key advantage of SFA, noting that it accommodates situations where farmers lack access to precise and current data about their operations, making the use of SFA feasible even with potentially inaccurate data. In the context of poultry production, the stochastic frontier technique develops a frontier function that accounts for both random errors and the inefficiency component specific to this industry.
The stochastic production function is given by:

$Y_i = f(X_i, \beta) * e^{v_i - u_i}$…………………………………………………. (5)

where
Yi = Output (weight of broiler chickens at 8 weeks);
Xi= Input (quantities: labor, capital, and other inputs directly used in production);
β = Projected parameters;
e= 2.718;
vi = Effects of exogenous shocks;
ui = Technical inefficiency effect.
The composite error term consists of two components: vi and ui. vi represents natural errors and follows a standard normal distribution, while ui represents farm-specific errors and follows an independent, half-normal distribution. These two error terms are unrelated to each other. vi data reflect deviations between maximum and actual values due to natural factors, while ui data capture inefficiencies specific to farmers. Different assumptions about the distribution of ui exist, including a half-normal distribution as proposed by Aigner et al., (1977), an exponential distribution by Meeusen and Van-den-Broeck, (1977), and a truncated normal distribution by Stevenson, (1980). The TE is calculated as follows:

$TE = \frac{Y_i}{Y_i^*} = \exp(-u_i)$………………………………………………..(6)

The technical efficiency (TE) of a farmer, as expressed in Equation (3), is calculated by comparing their actual output (Y) to the best possible output (Y*) achievable under the same technological conditions. SFA employs maximum likelihood estimation (MLE) to quantify this efficiency. To pinpoint the factors influencing observed technical inefficiency, equation (7) was utilized within a single-stage maximum likelihood estimation procedure, incorporating a stochastic frontier model using (Stata Corp, 2023).

$u_i = \alpha_0 + \sum_{i=1}^{n} \alpha_i Z_i + e_i$……………………………………….(7)

where

μi = Technical inefficiency error term of the ith farmer;

Zi = Socioeconomic status, institutional factors, and psychological well-being of broiler chicken farmers

αo = Constant;

αi = Estimated parameters;

εi = Error term.

Measurement of subjective socioeconomic status and psychological well-being

Subjective Socioeconomic Status

This study employed the traditional MacArthur SSS scale, comprising a 10-point social ladder, to evaluate participants' position in the social hierarchy based on income, educational level, and occupation. Participants selected the ladder rung that best represented their relative societal standing, with higher rungs indicating a higher position on the ladder. For subjective perceptions, researchers developed three adapted 10-rung ladders for income, education, and occupation. Participants indicated their perceived position on each ladder. The income ladder gauged income perceptions, with higher rungs denoting more income. The education ladder assessed educational level perceptions, with higher rungs indicating greater education.

The occupation ladder measured occupational status perceptions, with higher rungs reflecting better jobs. However, the scale has limitations, including subjective perceptions and a narrow focus on income, education, and occupation. These limitations include assumptions of a linear relationship between ladder rungs and social status, overlooking intersectionality, and potentially oversimplifying social hierarchies. Future research should address these constraints by incorporating a wider range of indicators, considering intersectionality, and employing qualitative methodologies.

Psychological wellbeing

The Swedish version of Ryff's Psychological Well-Being Scales, consisting of 18 items rated on a 6-point Likert scale, was used in the study. This version has been validated and proven reliable in various studies (Garcia et al., 2023; Khanjani et al., 2014). The specific items from each subscale utilised were: Q15, Q17, and Q18 for autonomy; Q4, Q8, and Q9 for environmental mastery; Q11, Q12, and Q14 for personal growth; Q6, Q13, and Q16 for positive relations with others; Q3, Q7, and Q10 for purpose in life; and Q1, Q2, and Q5 for self-acceptance. The data were rated on a 6-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree) (Ryff and Keyes, 1995).

How to Score and Interpret the Results

Step 1: The first step in scoring responses on these scales is to reverse-score each of the negatively worded items before totaling all the values.

The formula for reverse-scoring an item is:

(Number of scale points + 1) – (Respondent’s answer)

For example, if a person gave a value of three in response to one of the negatively worded items and the scale had seven points, this response was changed to a value of 5: (7 + 1) – 3 = 5. This was then used alongside the positive scores.

Step 2: For each question on the questionnaire, the study calculated the total number of responses for each sentiment level from 1 (strongly disagree) to 7 (strongly agree).

Step 3: Add the totals (positive and reversed negative scores) and divide by the total number of respondents.

Step 4: Generate a mean for each construct (autonomy, environmental mastery, personal growth, positive relations with others, purposeful life, self-acceptance) for each respondent. This study calculates the average of the number of questions for each construct to obtain a sentiment score for the target construct for each respondent.

Analytical Technique

Pearson Correlational Analysis

Pearson correlation analysis was used to explore the relationships between the objective and the MacArthur SSS subscales (subjective SES) of the owners of the broiler farms in the study area. This study adapted the procedure used by Garcia et al., (2023)

$$r_{xy} = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum(x_i - \bar{x})^2(y_i - \bar{y})^2}} \text{……………………………………………………}(8)$$

where

r = correlation coefficient

x_i = values of the x-variable in a sample

$\bar{x}$ = mean of the values of the x-variable

y_i = values of the y-variable in a sample

$\bar{y}$ = mean of the values of the y-variable

x_1=Age, x_2=Income, x_3=Education (Years in School), x_4=Occupation (Experience), x_5 =Income Level, x_6=Educational Level, x_7=Occupational Level; y_1=Age, y_2=Income, y_3=Education (Years in School), y_4=Occupation (Experience), y_5 =Income Level, y_6=Educational Level, y_7=Occupational Level

The correlation coefficient is estimated as:

row 1: $r_{x_1y_1}, r_{x_1y_2}, r_{x_1y_3} \ldots r_{x_1y_7}$

row 2: $r_{x_2y_1}, r_{x_2y_2}, r_{x_1y_3} \ldots r_{x_2y_7}$

row 3: $r_{x_3y_1}, r_{x_3y_2}, r_{x_1y_3} \ldots r_{x_3y_7}$

.

.

.

Row 7: $r_{x_7y_1}, r_{x_7y_2}, r_{x_1y_3} \ldots r_{x_7y_7}$

Regression Analysis

Following the Cobb–Douglas (CD) production model, the analytical model for this study is shown in equation 8:

$$lnY_i = \beta_0 + \beta_1 lnX_1 + \beta_2 lnX_2 + \beta_3 lnX_3 + \beta_4 lnX_4 + \beta_5 lnX_5 + \beta_6 lnX_6 + v_i - u_i \text{……..}(9)$$

where

Y = Output (weight broilers sold in kg per production cycle);

X1 = Number of broilers per production cycle;

X2 = Labour in man-days per production cycle;

X3 = Feed intake in kg per production cycle;

X4 = Quantity of water consumed in litres per production cycle;

X5 = cost of veterinary services per production cycle;

X6 = Volatility of temperature during the production cycle;

βo = Constant;

βi = Estimated parameters;

vi = Uncertainty errors;

ui = Inefficiency effects.

Technical Inefficiency Variables (Recall equation 7)

$$u_i = \alpha_0 + \sum_{i=1}^{14} \alpha_i Z_i + e_i \text{………………………………………..}(10)$$

Z1 = gender (0 for women; 1 for men)

Z2 = Age of household head (in years)

Subjective SES Domain

Z3 = Income (Producers' perception of his/her income level relative to others in the farm hosting location)

Z4 = Education (Producers' perception of his/her educational level relative to others in the farm hosting location)

Z5 = Occupation (Producers' perception of his/her years of experience relative to others in the farm hosting location)

Institutional Domain

Z6 = presence of lending institutions within the broiler farm hosting community. (yes=1, 0 otherwise)

Z7 = Financial Members of Cooperative (1 if yes, and 0 otherwise)

Z8 = extension visit in number of times visited

Psychological Well-Being

Z9 = Autonomy (1 (strongly disagree) to 7 [strongly agree])

Z10 = Environmental Mastery (EM: 1 [strongly disagree] to 7 [strongly agree])

Z11 = Personal growth (1 (strongly disagree) to 7 [strongly agree])

Z12 = Positive Relationships (1 [strongly disagree] to 7 [strongly agree])

Z13 = Purpose of Life (1 [strongly disagree] to 7 [strongly agree])

Z14 = Self-acceptance (1 [strongly disagree] to 7 [strongly agree])

Data collection

This study entailed gathering and analysing primary data through a structured questionnaire administered via interviews. The questionnaire included both closed- and open-ended questions and covered a range of topics such as farmers' demographics, institutional factors, input utilisation, and output from the 2023 production season (October-December). During the interviews, farmers were also queried about the average temperature during this production period. In cases where farmers lacked temperature data, weather information from local organisations in the community was used.

A team of 36 enumerators from the study area conducted interviews with 323 respondents, with each local government area (LGA) having three enumerators responsible for broiler farmer data collection. Ethical protocols were followed, and participants provided consent for the interviews. Enumerators were selected based on their knowledge of the study area, acceptance by local farmers, experience in data collection, and proficiency in the local language. The questionnaire underwent refinements after necessary adjustments, and a pretest was conducted to ensure detailed and accurate data collection. Out of the 323 questionnaires administered, 318 were deemed suitable for data analysis based on completeness and consistency of responses.

Ethical considerations

The study was approved by the Faculty of Agriculture Ethics Review Board of Adekunle Ajasin University, Akungba Akoko, Nigeria (AAUA/AGRIC/ERB/2305168).

4. RESULTS AND DISCUSSION

This study aimed to determine the socioeconomic characteristics of broiler farm entrepreneurs and the relationships among the socioeconomic characteristics (global indicators and MacArthur SSS subscales), psychological well-being and technical efficiency of these entrepreneurs. In this section, the results of the two objectives of the study are presented.

Socioeconomic Characteristics

Table 1 displays the socioeconomic characteristics of the respondents (smallholder broiler farmers). The table indicates that the average age of male broiler farmers was 57 years, while that of female broiler farmers was 43 years. Male producers had an average income of N285,049, whereas female producers had an average income of N215,714. On average, male broiler producers spent 16 years in school, while female producers spent 14 years. Male producers, as per the table, managed 426 broilers weighing 759 kg in a production cycle, with female producers managing 110 broilers weighing 317 kg, each requiring 88 and 83 man-days of labour, respectively. Male-managed broiler poultry pens exhibited greater feed intake, with males' broilers consuming 1386.06 kg of feed per production cycle compared to females' broilers consuming 1190.7 kg. Similarly, male-owned broiler farms consumed 805.2 litres of water on average, while female-owned farms consumed 1004.7 litres per production cycle. Female-owned farms incurred slightly higher costs for veterinary services, spending an average of N41,615.11 compared to N38,268.54 spent by male-owned farms.

Moreover, female-owned broiler farms experienced slightly higher temperatures during production, averaging 25.90 compared to 24.50 for male-owned farms. In terms of subjective SES perceptions, participants rated their positions on different ladders, as shown in

(Table 1). Male broiler farmers rated their perceived income at an average of 4.94, while female broiler farmers rated it at 3.86, indicating that males perceive themselves to have higher incomes. Males also rated their perceived educational level and occupational status higher than females, with average ratings of 4.51 and 5.85, respectively, compared to 4.02 and 3.95 for females. Regarding Ryff's psychological well-being assessment, participants rated their levels on different factors, as depicted in (Table 1). Male broiler farmers rated their autonomy, environmental mastery, personal growth, positive relationships, purpose in life, and self-acceptance higher than females did across all factors, suggesting a perceived higher level of well-being among males in these aspects.

Table 1 Socioeconomic Characteristics of Smallholder Broiler Farmers

	Male (227)				**Female (91)**			
	Max	**Min**	**Mean**	**SD**	**Max**	**Min**	**Mean**	**SD**
Objective SES								
Age	82	22	57.3	19.1	64	31	42.7	15.4
Income/cycle	903,311	64,185	285,049	52,118	491,521	38,557	215,714	47,022
Education Status/Years in School	22	9	15.8	3.82	18	12	14.1	2.65
Occupational Status/Experience	56	3	23.5	6.44	35	2	21.7	7.19
Output (weight broilers sold in kg per production cycle)	3,116.00	382	758.53	124.17	2153	317	533.1	156.3
Number of broilers per production cycle	1000	100	426.37	144.8	803	110	403.0	188.4
Labour in man-days per production cycle	128	62	88.06	24.2	110	49	83.3	31.5
Feed intake in kg per production cycle	2200	250	1386.06	115.3	1800	128	1190.7	88.9
Quantity of water consumed in litre per production cycle	1750	639	805.2	68.8	1442	550	1004.7	72.4
Cost of Veterinary Services per production cycle	156,044.08	38,268.54	59,233.72	21,902.14	182,226.37	25,131.41	41,615.11	18.002
Average temperature during the production cycle	32	17	24.5	6.54	29	18	25.9	6.61
Subjective SES								
Income Level	9	1	4.94	1.83	7	2	3.86	1.31
Educational Level	9	3	4.51	1.16	7	1	4.02	1.71
Occupational Level	10	2	5.85	2.55	6	3	3.95	1.49
Psychological								
Autonomy	5.72	1.68	4.69	1.14	5.35	1.51	3.16	1.75
Environmental Mastery	5.24	1.15	3.51	1.62	5.02	1.77	3.01	1.04
Personal Growth	5.25	1.64	4.18	1.18	4.42	1.93	3.88	1.01
Positive Relation	5.73	2.82	3.05	1.52	5.85	2.01	4.26	1.14

Purpose of Life	5.29	2.02	3.52	0.51	5.59	1.84	3.92	1.10
Self-Acceptance	5.16	1.08	3.38	1.02	5.06	2.11	4.01	1.15

Source: Field Survey, 2023

Correlational Analysis

Table 2 displays the Pearson correlations between objective and subjective SES variables and psychological well-being. The table reveals that these correlations demonstrate associations of different strengths between objective SES indicators (like income per cycle, education level, and occupational status) and subjective perceptions of SES (income level, educational level, and occupational level). Notably, the strength of these associations differs based on income per cycle, subjective income level, and subjective occupational level. This evidence justifies excluding both objective and subjective SES from the regression model to prevent issues like multicollinearity.

Table 2 Pearson correlations of objective and subjective SES indicators with psychological well-being

		Age	**Income /cycle**	**Education Status/Years in School**	**Occupational Status/Experience**	**Income Level**	**Educational Level**	**Occupational Level**
1	Age	1.00	-	-	-	-	-	-
2	Income/cycle	0.34*	1.00	-	-	-	-	-
3	Education (Years in School)	0.41*	0.49**	1.00	-	-	-	-
4	Occupation (Experience)	0.58**	0.62**	0.34*	1.00	-	-	-
5	Income Level	0.27	0.58***	0.21*	0.49**	1.00	-	-
6	Educational Level	0.16	0.38*	0.50***	0.43**	0.34*	1.00	-
7	Occupational Level	0.29	0.34*	0.28*	0.48**	0.41**	0.39**	1.00

Source: Data Analysis, 2024

Maximum Likelihood Estimates of the Stochastic Production Frontier Parameters

Table 3 displays the maximum likelihood estimates of the Cobb–Douglas stochastic frontier analysis with the inefficiency effect model applied to broiler farms. The variance parameters derived from this analysis are essential for gauging production efficiency in these farms. A sigma squared (σ^2) value of 0.44 signifies the variability of the error terms around the estimated frontier, indicating the presence of significant unexplained factors affecting production outcomes. The gamma (γ) value of 0.81 suggests that inefficiency makes a substantial contribution to overall variability, highlighting operational differences among farms. A sigma-v2 (σ_v^2) of 0.01 reflects the variability in inefficiencies, showcasing varying levels of farm efficiency. The sigma-u2 (σ_u^2) value of 0.34 indicates the impact of unexplained factors on production. The Prob > chi2 value of 0.00 denotes statistical significance, underscoring the importance of these variance parameters in elucidating production variability and inefficiencies within broiler farming.

Table 3 Maximum likelihood estimates of the Cobb–Douglas stochastic frontier analysis) with the inefficiency effect model (broiler farms).

Variables	**Coefficients**	**Standard Error**	**P Value**
Stochastic Frontiers			
Constant	-0.47***	0.008	0.000
X1=Number of broilers per production cycle	0.12***	0.001	0.000
X2=Labour (man-days per production cycle)	0.05	0.046	0.139
X3=Feed intake in (kg per production cycle)	0.38***	0.011	0.000
X4=Quantity of water consumed in litre per production cycle	0.04	0.099	0.343
X5=Cost of Veterinary Services per production cycle	0.07	0.061	0.126
X6=temperature volatility during the production cycle	-0.09***	0.001	0.000
Inefficiency Model			
Constant	1.38***	0.206	0.000
Z1=Age	-0.56*	0.422	0.092
Z2=Gender (Male)	-0.11	0.088	0.105
Z3=Income Level	-0.19***	0.016	0.000
Z4=Educational Level	-0.27***	0.013	0.000
Z5=Occupational Level	0.10	0.079	0.103
Z6=Lending Institution	-0.02	0.016	0.106
Z7=Cooperative Membership	-0.08**	0.041	0.026
Z8=Extension Visits	-0.06	0.051	0.120
Z9=Autonomy	-0.01**	0.005	0.023
Z10=Environmental Mastery	0.05	0.044	0.128
Z11=Personal Growth	-0.17***	0.02	0.000
Z12=Positive Relation	-0.03	0.027	0.133
Z13=Purpose of Life	-0.05**	0.038	0.006
Z14=Self-Acceptance	-0.01	0.011	0.182
Variance parameters			
Sigma Squared	0.44	-	-
Gamma	0.81	-	-
Sigma -v2	0.01	-	-
Sigma-u2	0.34	-	-
Prob > chi2	0.00	-	-

Source: Data Analysis, 2024

The stochastic frontier analysis (SFA) model, illustrated in Table 3, offers valuable insights into the factors influencing production efficiency in broiler farming. In the Production Function Model, the constant term (-0.47) is statistically significant (P value < 0.00), indicating its substantial impact on the outcome variable. Notably, the number of broilers per production cycle (X1) had a significant positive effect (0.12, P value < 0.00), indicating that increasing broiler numbers enhances production output (overall weight of broiler chicken to be produced). Similarly, feed intake (X3) significantly improved output (0.38, P value = 0), highlighting its crucial role in production processes. However, factors such as labour input (X2), water consumption (X4), and veterinary service costs (X5) do not show statistically significant impacts on efficiency. Interestingly, temperature volatility during production (X6) was statistically significant (-0.09, P value = 0), indicating its negative influence on production output, possibly by increasing stress on broilers.

In the inefficiency model, the constant term (1.38, P value = 0) signifies inherent inefficiencies or fixed costs in broiler farming. Age (Z1) and gender (Z2) do not have statistically significant impacts on inefficiencies, despite their negative coefficients (-0.56 and -0.11, respectively). However, concerning subjective socioeconomic SES, income level (Z3) and educational level (Z4) show significant negative coefficients (-0.19 and -0.27, respectively, both with P values = 0), indicating that farmers' higher ratings of their perceptions of themselves on income and education ladders relative to others are associated with lower inefficiencies. Among other factors, cooperative membership (Z7), autonomy (Z9), purpose of life (Z13), and self-acceptance (Z14) significantly impact inefficiencies. These results suggest that aspects related to psychological well-being and organizational factors can play a crucial role in reducing inefficiencies in broiler farming operations.

Technical Efficiency Level

Table 4 illustrates the distribution of respondents based on their technical efficiency level. Analysing these findings, the majority of respondents (60.06%) display a technical efficiency level ranging from 0.31 to 0.60. A significant portion (23.27%) demonstrates an efficiency level below 0.30, indicating a necessity for enhancements in their operational processes or resource utilisation. Conversely, a smaller yet noteworthy percentage (16.67%) of respondents exhibit a high efficiency level surpassing 0.61, implying effective practices or optimal resource allocation in their operations.

Table 4 Distribution of Respondents by Their Technical Efficiency

Efficiency	Frequency	Percentage
≤ 0.30	74	23.27
0.31 - 0.60	191	60.06
≥ 0.61	53	16.67

Source: Data Analysis of the Field Survey, 2023.

Discussion on the Effects of Farmers' Subjective and Psychological Well-Being on Their Technical Efficiency

This study aims to explore the correlations between MacArthur Subjective Socioeconomic Status, Ryff's Psychological Well-Being, and the Technical Efficiency of Small-scale Poultry Farmers in Southwest Nigeria. The results from the study indicated a statistically significant coefficient (0.12, p value < 0.00) for the number of broilers per production cycle. This discovery, consistent with Khan et al., (2022) and Yenibehit et al., (2019), suggests that increasing broiler numbers per cycle significantly enhances production output. Thus, policies encouraging farmers to expand operations could yield benefits. Onyewuchi et al., (2019) also noted that increasing broiler stocking density influenced economies of scale in broiler farming. Given the importance of broiler stocking density, authors have recommended incentives for scaling up, efficient broiler management training, and better access to quality chicks (Gill et al., 2021; Ramukhithi et al., 2023).

Additionally, the statistically significant coefficient (0.38, p value = 0) for feed intake indicates its positive impact on production output, echoing Baracho et al, (2019) findings on factors influencing broiler production output. This underscores the importance of proper feeding practices and nutrition in maximising broiler production efficiency, suggesting that increased feed intake can lead to higher broiler weights and improved production efficiency. Franklin et al., (2022) highlighted the significance of quality feed intake with adequate mineral elements to optimise broiler production. Moreover, the statistically significant coefficient (-0.09, p value = 0) for volatile temperature during production indicates its adverse effect on production output, aligning with Apalowo et al., (2024) research on heat stress's detrimental effects on poultry birds. Also noted temperature shocks' constraints on agricultural production.

These findings emphasise the need for stable temperature conditions during broiler production to reduce stress on broilers and enhance production efficiency, highlighting the importance of proper temperature control and management practices in broiler farming. Numerous empirical studies have examined factors contributing to broiler production efficiency, identifying two main types of factors with significant impacts. Firstly, demographic characteristics (age) Yenibehit et al., (2019), Ullah et al., (2019) and education Yenibehit et al., (2019), Oleke and Isinika, (2011) of farmers play crucial roles in determining technical efficiency. Older and more experienced farmers tend to exhibit higher efficiency levels, while education positively influences technical efficiency as educated farmers make more informed decisions. Secondly, institutional factors such as access to credit, cooperative membership, and extension services significantly affect farmers' technical efficiency (Yenibehit et al., 2019; Ullah et al., 2019).

Cooperative members demonstrate higher operational efficiency. These findings align with prior research in the field (Khan et al., 2022; Bethel et al., 2016). This analysis delves into how different aspects of Ryff's psychological well-being influence the technical inefficiency of poultry farmers in Nigeria. Table 3 sheds light on their respective impacts on technical inefficiency. The coefficient for autonomy is -0.01 and statistically significant ($p = 0.023$), suggesting that increased autonomy slightly decreases technical inefficiency. This aligns with Gupta and Jena, (2024) focus on holacracy and self-managed teams, indicating that reducing external constraints and enhancing decision-making power can lead to efficiency gains. Similarly, Antonio et al., (2024) note that autonomy promotes innovation and better resource management. Therefore, policies aimed at granting poultry farmers more autonomy—such as providing greater control over operations and reducing bureaucratic hurdles—could boost technical efficiency.

Empowering farmers through training, financial aid, and infrastructure that supports independent decision-making could be effective in enhancing agricultural productivity. The coefficient for personal growth is -0.17 and highly significant ($p < 0.001$), indicating that a strong sense of personal growth significantly reduces technical inefficiency. This is supported by Goldin, (2024) emphasis on the economic benefits of human capital accumulation and Papanek, (2024) focus on industrial efficiency through technical education. Policies promoting personal growth among farmers—such as educational programs, workshops, and access to new technologies—can greatly enhance technical efficiency. Investing in farmers' continuous education and development ensures they can utilise resources more effectively, leading to higher productivity in agriculture. The coefficient for purpose in life is -0.05 and statistically significant ($p = 0.006$), showing that a strong sense of purpose reduces technical inefficiency.

This is consistent with Khefacha et al., (2024) emphasis on entrepreneurial aspirations and Hamid et al., (2024) findings on shared goals enhancing motivation and efficiency. Policies supporting farmers in setting and achieving clear goals—through workshops, mentorship, and progress-sharing platforms—can significantly improve technical efficiency. By helping farmers define and pursue objectives, policymakers create an environment where farmers are more focused, motivated, and efficient in their operations. Analyzing Ryff's psychological well-being dimensions indicates that autonomy, personal growth, and purpose in life reduce technical inefficiency among poultry farmers in Nigeria. This suggests that policies fostering farmer autonomy, continuous personal development, and goal-setting could enhance technical efficiency. Conversely, environmental mastery, positive relations, and self-acceptance show no significant impact, indicating other factors may be more influential. Policymakers should prioritize strategies that empower farmers and support their growth, both personally and professionally, to enhance productivity in the poultry sector.

5. CONCLUSION AND RECOMMENDATIONS

This study exploring the relationships between MacArthur Subjective Socioeconomic Status (SES), Ryff's Psychological Well-Being, and Technical Efficiency among small-scale poultry farmers in Southwest Nigeria provides valuable insights for policy development. Notably, increasing the number of broilers per production cycle significantly boosted production output, consistent with prior research highlighting the advantages of scaling up operations. This indicates a need for policies that encourage farmers to expand their broiler numbers and invest in efficient broiler management.

Furthermore, the importance of feed intake in influencing production output underscores the crucial role of proper feeding practices and nutrition in maximising broiler production. This aligns with existing literature, suggesting that policies focusing on affordable, high-quality feed and promoting local feed production could enhance production efficiency. The adverse impact of volatile temperature during production-on-production output highlights the importance of implementing proper temperature control and management practices. Policies that support infrastructure for maintaining stable temperatures can alleviate stress on broilers, thereby improving production efficiency.

Policy recommendations

Scaling Operations: Provide financial incentives and training programs to encourage farmers to increase broiler numbers and adopt efficient broiler management practices.

Nutrition and Feed Management: Offer subsidies for high-quality feed, promote local feed production, and provide training on optimal feeding practices.

Infrastructure and Environmental Control: Provide grants or low-interest loans for climate-controlled poultry houses and conduct educational campaigns on temperature management practices.

Human Capital Development: Investing in continuous education and development opportunities for farmers to enhance their technical skills and decision-making capabilities.

Goal Setting and Achievement: Implement goal-setting workshops, mentorship programs, and platforms for sharing progress to help farmers set and achieve clear goals, ultimately improving focus, motivation, and efficiency.

Informed consent

Written & Oral informed consent was obtained from participants included in the study.

Ethical approval

The ethical guidelines for Human Subjects are followed in the study.

Conflicts of interests

The authors declare that there are no conflicts of interests.

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Data and materials availability

All data associated with this study are present in the paper.

REFERENCES

1. Adesehinwa AOK, Plantation M, Cho GR, Oyegbami A, Omole AJ. Production Systems and Constraints in Market-oriented Smallholder Chicken Production in Southwest States of Nigeria. J Korean Soc Int Agric 2016; 28(4):459-466. doi: 10.12719/KSIA.2016.28.4.459
2. Adler NE, Epel ES, Castellazzo G, Ickovics JR. Relationship of subjective and objective social status with psychological and physiological functioning: Preliminary data in healthy white women. Health Psychol 2000; 19(6):586-592. doi: 10.1037/0278-6133.19.6.586
3. Aigner D, Lovell CAK, Schmidt P. Formulation and estimation of stochastic frontier production function models. J Econom 1977; 6(1):21-37. doi: 10.1016/0304-4076(77)90052-5
4. Ajibefun I, Daramola A, Falusi A. Technical efficiency of small scale farmers: An application of the stochastic frontier production function to rural and urban farmers in Ondo State, Nigeria. Int Econ J 2006; 20(1):87-107. doi: 10.1080/10168730500515498
5. Alice M. Global Poultry Trends – Developing Countries Main Drivers in Chicken Consumption 2016.
6. Alston M, Kent J. The Big Dry: The link between rural masculinities and poor health outcomes for farming men. J Sociol 2008; 44:133–147. doi: 10.1177/1440783308089166
7. American Psychological Association. Publication manual of the American Psychological Association. 6th ed. American Psychological Association 2007.
8. Antonio JL, Schmidt AL, Kanbach DK, Meyer N. Enacting disruption: how entrepreneurial ventures innovate value propositions to increase the attractiveness of their technologies. Int J Entrep Behav Res 2024; 30(4):885-915. doi: 10.1108/IJEBR-07-2023-0688
9. Apalowo OO, Ekunseitan DA, Fasina YO. Impact of Heat Stress on Broiler Chicken Production. Poultr 2024; 3(2):107-128. doi: 10.3390/poultry3020010
10. Azarpajouh S, Weimer SL, Calderón Díaz JA, Taheri H. Smart farming: A review of animal-based measuring technologies for broiler welfare assessment. CABI Reviews 2022.
11. Baracho MS, Nääs IA, Lima NDS, Cordeiro AFS, Moura DJ. Factors affecting broiler production: A meta-analysis. Braz J Poultry Sci 2019; 21(3):001-010.
12. Battese GE, Coelli T. A model for technical inefficiency effects in a stochastic frontier production function for panel data. Empir Econ 1995; 20(2):325-332.
13. Battese GE, Corra GS. Estimation of a production frontier model: with application to the pastoral zone of Eastern Australia. Aust J Agric Econ 1977; 21(3):169-179.

14. Bethel E, Fani DR, Odufa EM. Analysis of technical efficiency of poultry farmers in Cross River State, Nigeria. Int J Res Stud Agric Sci (IJRSAS) 2016; 2(4):40-45. doi: 10.20431/2454-6224.0204005
15. Bjornsdottir RT, Alaei R, Rule NO. The perceptive proletarian: subjective social class predicts interpersonal accuracy. J Nonverb Behav 2017; 41:185–201. doi: 10.1007/s10919-016-0248-6
16. Blackie S. Contribution of Village Chickens to Animal Protein Consumption and Income of Rural Households in the Greater Accra Region, Ghana. Dev Country Stud 2014; 4(10):43–48.
17. Bourke L, Humphreys JS, Wakerman J, Taylor J. Understanding rural and remote health: a framework for analysis in Australia. Health Place 2012; 18(3):496-503. doi: 10.1016/j.healthplace.2012.02.009
18. Brew B, Inder K, Allen J, Thomas M, Kelly B. The health and wellbeing of Australian farmers: A longitudinal cohort study. BMC Public Health 2016; 16:988. doi: 10.1186/s12889-016-3664-y
19. Butterworth A. Cheap as chicken. In The Meat Crisis. Routledge; 2017; 155-171.
20. Central Bank of Nigeria (CBN). Monetary Policy Committee Communique No. 152, 2024.
21. Cobb CW, Douglas PH. A theory of production. Am Econ Rev 1928; 18(1):139-165.
22. Cochran WG. Sampling Techniques. 3rd ed. New York: John Wiley and Sons, Inc; 1977.
23. Coelli TJ. Recent developments in frontier modelling and efficiency measurement. Aust J Agric Econ 1995; 39(3):219–245.
24. Destin M, Rheinschmidt-Same M, Richeson JA. Status-based identity: A conceptual approach integrating the social psychological study of socioeconomic status and identity. Perspect Psychol Sci 2017; 12(2):270-289. doi: 10.1177/1745691616664424
25. Diener E, Seligman MEP. Beyond money: Toward an economy of well-being. Psychol Sci Public Interest 2004; 5(1):1-31. doi: 10.1111/j.0963-7214.2004.00501001.x
26. Duncan GJ, Magnuson K. Socioeconomic status and cognitive functioning: moving from correlation to causation. Wiley Interdiscip Rev Cogn Sci 2012; 3(3):377-386. doi: 10.1002/wcs.1176
27. Erdaw MM, Beyene WT. Trends, prospects and the socioeconomic contribution of poultry production in sub-Saharan Africa: a review. Worlds Poult Sci J 2022; 78(3):835-852. doi: 10.1080/00439339.2022.2092437
28. FAOSTAT. Food and agriculture organization statistical data 2023.
29. Farrell MJ. The measurement of productive efficiency. J R Stat Soc Ser A 1957; 120(3):253-290. doi: 10.2307/2343100
30. FMA&NR. Nigeria: National Agricultural Research Strategy Plan: 1996-2010. Bukar Shaib, Adam Y; Department of Agricultural Sciences, Federal Ministry of Agriculture and Natural Resources, 1997.
31. Food and Agriculture Organization of the United Nations (FAO). Regional Overview of Food Insecurity in Africa. FAO: Rome, Italy; 2018.
32. Franklin SB, Young MB, Ciacciariello M. The impact of different sources of zinc, manganese, and copper on broiler performance and excreta output. Animals (Basel) 2022; 12(9):1067. doi: 10.3390/ani12091067
33. Galvan MJ, Payne BK, Hannay J, Georgeson AR, Muscatell KA. What does the MacArthur scale of subjective social status measure? Separating economic circumstances and social status to predict health. Ann Behav Med 2023; 57(11):929-941. doi: 10.1093/abm/kaad054
34. Garcia D, Kazemitabar M, Asgarabad MH. The 18-item Swedish version of Ryff's psychological wellbeing scale: psychometric properties based on classical test theory and item response theory. Front Psychol 2023; 14:1208300. doi: 10.3389/fpsyg.2023.1208300. Erratum in: Front Psychol 2023; 14:1324006. doi: 10.3389/fpsyg.2023.1324006
35. Garriga C, Hunter RR, Amat C, Planas JM, Mitchell MA, Moretó M. Heat stress increases apical glucose transport in the chicken jejunum. Am J Physiol Regul Integr Comp Physiol 2006; 290(1):R195-201. doi: 10.1152/ajpregu.00393.2005
36. Gill T, Nisengwe R, Goertz H, Ader D, McGehee K, Nshuti R, Urban E. Strengthening smallholder engagement and integration in the Rwandan commercial broiler value chain. Worlds Poult Sci J 2021; 77(4):1059-1078. doi: 10.1080/00439339.2021.1975523
37. Goldin C. Human capital. In Handbook of cliometrics, Claude Diebolt & Michael Haupert (ed.). Cham: Springer International Publishing; 2024; 353-383. doi: 10.1007/978-3-031-35583-7_23
38. Gunasekera D, Kim Y, Tulloh C, Ford M. Climate change-impacts on Australian agriculture. Aust Commod 2007; 14:657–676.
39. Gupta A, Jena LK. Respect my authority: spiritual self-managed teams and holacracy. Manag Res J Iberoamerican Acad Manag 2024; 22(1):1-17. doi: 10.1108/MRJIAM-11-2022-1360

40. Hamid RS, Ukkas I, Goso G, Abror A, Anwar SM, Munir AR. The role of social media in building trust, self-perceived creativity and satisfaction for millennial entrepreneurs. J Small Bus Enterp Dev 2024; 31(2):377-394. doi: 10.1108/JSBED-11-2022-0482
41. Huang S, Hou J, Sun L, Dou D, Liu X, Zhang H. The effects of objective and subjective socioeconomic status on subjective well-being among rural-to-urban migrants in China: The moderating role of subjective social mobility. Front Psychol 2017; 8:819. doi: 10.3389/fpsyg.2017.00819
42. Iliya NR, Oladimeji YU, Ojeleye OA, Jabil IY, Mani JR. Determinants of broiler production and its effects on poverty status among civil servants in Jos metropolis, Plateau State, Nigeria. DIEM: Dubrovnik Int Econ Meet 2024; 9(1):12-23. doi: 10.17818/DIEM/2024/1.2
43. Jury M, Aelenei C, Chen C, Darnon C, Elliot AJ. Examining the role of perceived prestige in the link between students' subjective socioeconomic status and sense of belonging. Group Process Int Relat 2019; 22(3):356–370. doi: 10.1177/1368430219827361
44. Kállay É, Rus C. Psychometric properties of the 44-item version of Ryff's Psychological Well-Being Scale. Eur J Psychol Assess 2014; 30(1):15–21. doi:10.1027/1015-5759/a000163
45. Khan NA, Ali M, Ahmad N, Abid MA, Kusch-Brandt S. Technical efficiency analysis of layer and broiler poultry farmers in Pakistan. Agric 2022; 12(10):1742. doi: 10.3390/agriculture12101742
46. Khanjani M, Shahidi S, Fathabadi J, Mazaheri MA, Shokri O. Factor structure and psychometric properties of the Ryff's scale of psychological well-being, short form (18-item) among male and female students. Thoughts Behav Clin Psychol 2014; 9(32):27-36.
47. Khefacha I, Romdhane R, Haj Salem H. Unveiling the relationship between entrepreneurial aspirations and prosperity: An international panel study using GEM data. Int Entrep Manag J 2024; 20(1):421-449. doi: 10.1007/s11365-023-00859-0
48. Kraus MW, Piff PK, Mendoza-Denton R, Rheinschmidt ML, Keltner D. Social class, solipsism, and contextualism: How the rich are different from the poor. Psychol Rev 2012; 119(3):546-572. doi: 10.1037/a0028756
49. Kraus MW, Tan JJX, Tannenbaum MB. The social ladder: a rank-based perspective on social class. Psychol Inq 2013; 24(2):81–96. doi: 10.1080/1047840X.2013.778803
50. Kukoyi O, Orok E, Oluwafemi F, Oluwadare T, Oni O, Bamitale T, Jaiyesimi B, Ojo T, Eze H. Factors affecting the utilization of mental health services among undergraduate students in a Nigerian University. Heliyon 2022; 8(11):e11476. doi: 10.1016/j.heliyon.2022.e11476
51. Leinonen I, Kyriazakis I. How can we improve the environmental sustainability of poultry production? Proc Nutr Soc 2016; 75(3):265–273. doi: 10.1017/S0029665116000094
52. Loeb E, Hurd NM. Subjective social status, perceived academic competence, and academic achievement among underrepresented students. J Coll Stud Ret: Res Theory Pract 2019; 21:150–165. doi: 10.1177/1521025117696821
53. Lucas RE, Schimmack U. Income and well-being: How big is the gap between the rich and the poor? J Res Pers 2009; 43(1): 75-78. doi: 10.1016/j.jrp.2008.09.004
54. Meeusen W, Van-Den-Broeck J. Efficiency estimation from Cobb–Douglas production functions with composed error. Int Econ Rev 1977; 18(2):435–444.
55. Mitchell MA, Kettlewell PJ. Physiological stress and welfare of broiler chickens in transit: Solutions not problems! Poult Sci 1998; 77(12):1803–1814. doi: 10.1093/ps/77.12.1803
56. Mottet A, Tempio G. Global poultry production: current state and future outlook and challenges. World's Poult Sci J 2017; 73(2):245-256. doi: 10.1017/S0043933917000071
57. Navarro-Carrillo G, Alonso-Ferres M, Moya M, Valor-Segura I. Socioeconomic status and psychological well-being: revisiting the role of subjective socioeconomic status. Front Psychol 2020; 11:1303. doi: 10.3389/fpsyg.2020.01303
58. Nwobodo CE, Okoronkwo DJ, Eze RI, Ozorngwu AM, Iwuchukwu JC, Azuka VC, Udoye CE. Knowledge capabilities for sustainable poultry production in Sub-Sahara Africa: Lessons from Southeast Nigeria. Sustainability 2023; 15(14):11174. doi: 10.3390/su151411174
59. Oakes JM, Rossi PH. The measurement of SES in health research: current practice and steps toward a new approach. Soc Sci Med 2003; 56:769–784. doi: 10.1016/S0277-9536(02)00073-4
60. Oleke JM, Isinika AC. Assessing the technical efficiency of commercial egg production in Tanzania for improved livelihoods. J Dev Agric Econ 2011; 3(8):343–352.
61. Onyewuchi UU, Ezebuike IR, Ohaka CC, Amanze PC, Okongwu G. Differentials in technical efficiency among broiler farmers in Imo State, Nigeria. Niger Agric J 2019; 50(2):45-55.
62. Papanek GF. Pakistan's development: Social goals and private incentives. Harvard University Press, 2024.
63. Perceval M, Ross V, Kõlves K, Reddy P, De-Leo D. Social factors and Australian farmer suicide: A qualitative study. BMC Public Health 2018; 18(1):1367. doi: 10.1186/s12889-018-6287-7

64. Pinstrup-Andersen P, Rosegrant MW. The unfinished agenda: perspectives on overcoming hunger, poverty, and environmental degradation. International Food Policy Research Institute, Washington, DC, 2001.
65. Ramukhithi TF, Nephawe KA, Mpofu TJ, Raphulu T, Munhuweyi K, Ramukhithi FV, Mtileni B. An Assessment of Economic Sustainability and Efficiency in Small-Scale Broiler Farms in Limpopo Province: A Review. Sustainability 2023; 15 (3):2030. doi: 10.3390/su15032030
66. Rickwood D, Thomas K, Bradford S. Help-seeking measures in mental health: A rapid review. Haymarket, NSW: Sax Inst. 2012.
67. Ryff CD, Keyes CL. The structure of psychological well-being revisited. J Pers Soc Psychol 1995; 69(4):719-27. doi: 10.1037/ /0022-3514.69.4.719
68. Samboko PC, Zulu-Mbata O, Chapoto A. Analysis of the animal feed to poultry value chain in Zambia. Dev South Afr 2018; 35(3):351-368. doi: 10.1080/0376835X.2018.1480932
69. Snibbe AC, Markus HR. You can't always get what you want: educational attainment, agency, and choice. J Pers Soc Psychol 2005; 88:703–720. doi: 10.1037/0022-3514.88.4.703
70. Star L, Decuypere E, Parmentier HK, Kemp B. Effect of single or combined climatic and hygienic stress in four-layer lines: 2. Endocrine and oxidative stress responses. Poult Sci 2008; 87 (6):1031–1038. doi: 10.3382/ps.2007-00143
71. Stata Corp. Stata 18 Software. StataCorp LLC: College Station, TX, USA, 2023.
72. Stevenson RE. Likelihood functions for generalized stochastic frontier estimation. J Econom 1980; 13(1):57–66.
73. Terfa DA, Terwase S. Efficiency of Resource Use in Rice Farming Enterprise in Kwande Local Government Area of Benue State, Nigeria. Int J Humanities Soc Sci 2011; 1(3):215-219.
74. Ullah I, Ali S, Khan SU, Sajjad M. Assessment of technical efficiency of open shed broiler farms: The case study of Khyber Pakhtunkhwa Province Pakistan. J Saudi Soc Agric Sci 2019; 18:361–366. doi: 10.1016/j.jssas.2017.12.002
75. UN. World Population Prospects 2019. United Nations, Department of Economic and Social Affairs, Population Division: New York, USA, 2019.
76. Upton M. The unproductive production function. J Agric Econ 1979; 30(2):179-194. doi: 10.1111/j.1477-9552.1979.tb01494.x
77. Van-Eerdewijk A, Danielsen K. Gender matters in farm power. Amsterdam: KIT, 2015.
78. Wang Z, Jetten J, Steffens NK. The more you have, the more you want? Higher social class predicts a greater desire for wealth and status. Eur J Soc Psychol 2019. doi: 10.1002/ejsp.26 20
79. Wilkinson R, Pickett K. The Spirit Level: Why Equality is Better for Everyone. London: Penguin, 2010; 42(4):347.
80. Wilton B. Exploring the Connection between Mental Health and Farm Management. Wilton Consulting Group, Farm Management Canada, 2019.
81. Woolford DD, Smout MF, Turnbull D, Gunn KM. Male farmers' perspectives on psychological wellbeing self-management strategies that work for them and how barriers to seeking professional mental health assistance could be overcome. Int J Environ Res Public Health 2022; 19(19):12247. doi: 10.3390/ijerph191912247
82. World Bank Group. Climate Change Knowledge Portal: For Development Practitioners and Policy Makers. World Bank Group, 2023.
83. Yenibehit N, Murshed M, Islam M. Assessment of technical efficiency of layer production in Mampong Municipality: Stochastic frontier approach. Curr Res Agric Sci 2019; 6(1):20–28.
84. Zhang Y, Chen H, Cong W, Zhang K, Jia Y, Wu L. Chronic heat stress affects bile acid profile and gut microbiota in broilers. Int J Mol Sci 2023; 24(12):10238. doi: 10.3390/ijms2412 10238