Research Article

The effect of the inclusion of feed enzymes on the performance growth of broiler chickens: A study in Juba, South Sudan

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Abstract

This study investigates the effect of including feed enzymes in broiler chicken diets on performance growth in Juba, South Sudan. Broiler production is crucial for food security, yet it faces challenges such as high feed costs, poor nutrient utilization, and limited technical knowledge. Feed enzymes offer a potential solution by improving nutrient digestibility, reducing anti-nutritional factors, and enhancing productivity. A mixed-methods research design was employed, combining quantitative and qualitative approaches. Data were collected from 44 purposively selected respondents, including broiler farmers, feed mill operators, poultry nutritionists, and extension officers. Primary data were obtained through semi-structured interviews and observation, while secondary data came from literature and industry reports. Quantitative data were analyzed using SPSS, while qualitative data were thematically analyzed using Excel. Findings reveal low awareness and adoption of feed enzymes, with 40.9% of respondents showing limited knowledge and 31.8% remaining neutral. Key challenges include high enzyme costs, limited availability, and inadequate technical training. However, respondents who adopted feed enzymes reported improved feed conversion ratio, weight gain, and economic returns. The study concludes that increased awareness, capacity building, and policy support are essential for broader adoption of feed enzymes. These findings provide practical insights for policymakers, industry stakeholders, and development partners to promote sustainable and cost-effective poultry production in South Sudan.

Background

The global demand for animal protein, especially poultry meat, has increased over the past few decades, driven by population growth, urbanization, and rising incomes. Broiler chickens are a highly efficient protein source, capable of rapid growth and high feed conversion ratios. Worldwide, the poultry industry is a key part of agricultural economies, with major players like the United States leading in production volume and technological progress, including advanced feed formulations and additive use. Similarly, the United Kingdom and other developed countries have highly optimized poultry sectors that regularly incorporate advanced nutritional strategies, such as feed enzymes, to maximize efficiency and profitability while reducing environmental impact (FAO, 2022).

However, the rapid intensification of poultry production also presents challenges, notably the rising cost of feed ingredients, which can make up to 70% of total production costs. This issue is especially severe in developing regions. Africa has seen significant growth in its poultry sector, but it often depends heavily on imported feed raw materials and has limited access to advanced feed technologies. In Sub-Saharan Africa, where food security remains a top concern, poultry has huge potential to provide affordable protein. Countries like Kenya, Uganda, and Tanzania are actively developing their poultry industries, yet high feed prices and inefficient nutrient use often restrict productivity and limit farmers' profits (Mutua et al., 2020).

South Sudan, a young country still recovering from prolonged conflict, faces even greater challenges in its agricultural sector. Despite having substantial agricultural potential, its animal production system, including poultry, is largely underdeveloped. Local feed production is minimal, forcing reliance on expensive imports, which strains farmers further. As a result, broiler performance in South Sudan often falls behind global standards, affecting both farmers' livelihoods and the national food supply. Finding cost-effective, efficient solutions to improve broiler performance is essential for the sustainable growth of South Sudan's animal production sector and for tackling widespread malnutrition (UNDP, 2021). Including feed enzymes could help reduce high feed costs by improving the use of locally available, often lower-quality, feed ingredients and increasing overall broiler production efficiency.

Problem Statement

Despite the well-documented and scientifically supported benefits of including feed enzymes in broiler diets, such as better nutrient digestion, improved feed conversion, faster growth, and lower feed costs, their systematic adoption and optimal use are very limited or almost nonexistent in South Sudan's emerging and struggling poultry industry. Broiler farmers in South Sudan face a highly difficult economic environment. They often deal with extremely high feed prices, caused by heavy reliance on imported feed ingredients and complete feed mixes (Mapiye et al., 2021). This dependency not only raises costs because of logistics, tariffs, and currency fluctuations but also results in an unreliable supply chain. Additionally, local feed resources like sorghum, millet, and cereal by-products are often underutilized because they are nutrient-poor or contain anti-nutritional factors (Ogbuewu et al., 2020). This reliance on costly, nutritionally deficient feeds causes slower growth rates, longer production cycles, higher costs, and much lower profits for smallholder and commercial farmers alike. Ultimately, this weakens food security by limiting the availability of affordable poultry meat (FAO, 2022). Current broiler practices in South Sudan largely overlook the potential of feed enzymes to unlock nutrients in common feed components. For example, local grains like sorghum contain non-starch polysaccharides (NSPs) that increase gut viscosity and hinder digestion, while plant-based phosphorus is mostly bound in phytates, making it unavailable to poultry (Rousseau et al., 2022). Exogenous enzymes, like xylanases and phytases, are designed to break down these anti-nutritional

factors, freeing energy, amino acids, and minerals that would otherwise be lost (Angel et al., 2023). Not utilizing this technology leads to ongoing nutrient wastage and unnecessary expenditure on inorganic mineral supplements. A major challenge is the lack of localized, context-specific data and awareness about enzyme use. There is little information on which enzyme types (single or multi-enzyme mixes) work best with the specific combination of imported and local feeds used in South Sudan. Details on optimal inclusion levels, effective dosages, and the actual economic returns are completely unknown (Mabelebele et al., 2022). Without this knowledge and targeted educational efforts, local farmers cannot make evidence-based decisions. They continue operating below their full productive and economic potential, slowing down the growth of a vital agricultural sub-sector critical for South Sudan's economic stability and nutrition. This study aims to fill this gap by exploring and documenting existing knowledge, perceived benefits, practical obstacles, and socio-economic factors related to introducing feed enzymes into broiler feeds in South Sudan. The results will help policymakers, feed producers, and farmers develop strategies to improve productivity and sustainability in the national poultry industry.

Study Objectives

This research primarily aims to explore how the incorporation of feed enzymes influences the growth performance of broiler chickens in South Sudan. The specific goals of the study include: 1. Evaluating the current awareness and adoption rates of feed enzymes among broiler chicken farmers and stakeholders in the feed industry within South Sudan. 2. Assessing the perceived effects of feed enzyme usage on essential performance metrics, such as body weight gain, feed conversion ratios, and mortality rates, as reported by farmers and industry professionals in the region. 3. Identifying the key challenges and potential opportunities for the broader implementation and sustainable application of feed enzyme technology in South Sudan's broiler production sector.

Significance of the Study

The findings of this research are expected to significantly contribute to various stakeholders involved in South Sudan's agricultural and economic development.

To Policymakers: This study provides evidence-based information to inform agricultural policies related to animal feed additives, import regulations, and potential subsidies for enzyme technologies. By demonstrating the economic and nutritional benefits of feed enzymes, policymakers can develop strategies that support the local poultry industry, enhance food security, and reduce reliance on imported meat. It can guide decisions on promoting education and extension services for farmers.

To the Animal Production Institution in South Sudan: The research will offer valuable insights into the current state of broiler production practices and the potential for technological upgrades within the country. This information can be used to tailor training programs, develop effective extension services, and formulate practical guidelines for the optimal use of feed enzymes. It will help the institution to prioritize research and development initiatives that are directly relevant to the local context, thereby improving overall animal productivity and farmer livelihoods.

To Researchers: This study will contribute to the existing body of knowledge on poultry nutrition, particularly in the under-researched context of South Sudan and similar developing regions. It will identify knowledge gaps regarding local feed ingredients, enzyme efficacy under varying conditions, and socio-economic factors influencing adoption. The findings will serve as a foundation for future, more in-depth experimental trials and economic analyses, encouraging a deeper understanding of sustainable broiler production practices in challenging environments.

Literature Review

Introduction

The growing demand for poultry meat necessitates constantly searching for innovative strategies to enhance production efficiency and sustainability. Feed enzymes have emerged as a pivotal technology in modern poultry nutrition, facilitating the breakdown of anti-nutritional factors and improving nutrient utilization from diverse feed ingredients. This literature review explores the theoretical underpinnings of enzyme action and synthesizes findings from empirical studies demonstrating their practical applications and benefits in broiler production.

Related Theories

Several theoretical frameworks underpin the efficacy of feed enzyme inclusion in broiler diets: Enzyme Kinetics and Substrate Specificity Theory: This theory explains how enzymes, as biological catalysts, accelerate specific biochemical reactions (e.g., hydrolysis) without being consumed in the process. Each enzyme has a specific active site that binds to a particular substrate (e.g., phytate, non-starch polysaccharides - NSPs), facilitating its breakdown into smaller, more digestible components. For instance, phytase targets phytate, releasing phosphorus and other chelated minerals, while xylanase and β-glucanase target NSPs found in cereal grains, reducing digesta viscosity and improving nutrient accessibility (Choct, 2015). Understanding enzyme kinetics helps in determining optimal dosage, pH, and temperature for enzyme activity within the broiler gut, crucial for maximizing their effectiveness.

Nutritional Physiology and Nutrient Digestion Theory: This theory focuses on the physiological processes of nutrient breakdown, absorption, and metabolism within the gastrointestinal tract of broilers. Broilers, like all monogastric animals, have inherent limitations in digesting complex carbohydrates and phytate due to a lack of specific endogenous enzymes. The inclusion of exogenous feed enzymes supplements the bird's natural digestive capacity, leading to a more complete breakdown of otherwise unavailable nutrients. This improved digestion results in enhanced nutrient absorption, leading to better growth, improved feed conversion, and reduced nutrient excretion, aligning with principles of sustainable animal agriculture (Ravindran, 2013).

Economic Efficiency Theory: This theory posits that any intervention in production must yield a net economic benefit to be adopted sustainably. In broiler production, feed represents the largest cost component. By improving nutrient digestibility, feed enzymes allow for the use of cheaper, often lower-quality, feed ingredients without compromising performance, or they enable a reduction in expensive nutrient supplementation (e.g., phosphorus, amino acids). This leads to a lower cost per unit of production (e.g., per kg of meat), thereby increasing the profitability for farmers. The economic efficiency theory drives the adoption of technologies like feed enzymes, as their cost must be outweighed by the savings in feed costs and/or the increase in revenue from improved broiler performance (Adeyemi et al., 2017).

Empirical Studies

Empirical research consistently underscores the significant role of feed enzymes in enhancing broiler production efficiency and sustainability.

For instance, Cowieson et al. (2018) conducted studies across various dietary formulations, highlighting phytase's efficacy in improving phosphorus digestibility, reducing the need for costly inorganic phosphorus, and subsequently lowering environmental phosphorus excretion, while consistently observing better body weight gain and feed conversion.

Similarly, Olukosi et al. (2017) investigated carbohydrase enzymes (xylanase and β-glucanase) in broiler diets high in wheat and barley, demonstrating their capacity to degrade

non-starch polysaccharides, thereby enhancing the digestibility of energy and amino acids and leading to superior growth rates. Further advancing the field, Amerah et al. (2019) showcased the benefits of multi-enzyme complexes, finding significant improvements in the digestibility of crude protein, fat, and metabolizable energy, alongside better broiler performance, by targeting a broader spectrum of anti-nutritional factors across diverse raw materials. Beyond performance, the economic viability of enzyme inclusion is robustly supported through research.

A notable study by Adeyemi et al. (2017), conducted within a developing country context, revealed that the investment in enzymes yielded a higher return on investment for farmers. This was achieved through cost savings derived from the ability to formulate diets with lower nutrient densities and further enhanced by improved feed conversion, proving enzymes to be a financially attractive strategy for sustainable production, particularly where feed ingredient costs are high or quality is variable. Collectively, these studies underscore the indispensable contribution of feed enzymes to optimizing nutrient utilization, improving broiler performance, and ensuring the economic and environmental sustainability of poultry farming globally.

Methodology

The methodology employed for this study adopted a comprehensive mixed-methods research approach, meticulously integrating both quantitative and qualitative techniques. This approach aimed to provide an in-depth understanding of feed enzyme adoption and its perceived impacts on broiler performance within South Sudan. The dual methodology was considered crucial for assessing the prevalence and perceived effects of enzyme utilization (quantitative data) while simultaneously delving into the deeper, contextual experiences, challenges, and opportunities faced by stakeholders (qualitative insights) (Creswell & Plano Clark, 2023). Triangulation of data from

these diverse methods was expected to significantly enhance the validity and reliability of the findings, offering a holistic and robust perspective on the complex phenomenon (Johnson et al., 2022). The target population for this research comprised key stakeholders actively involved in the broiler chicken production sector in South Sudan, including broiler farm owners/managers, feed mill representatives, poultry nutritionists, and animal husbandry extension officers, estimated at 50 individuals. From this target, a highly representative sample of 44 respondents (approximately 88%) was selected. A purposive sampling technique was employed to select individuals who possessed direct and relevant experience and knowledge regarding broiler chicken farming and feed practices, particularly concerning the use or consideration of feed enzymes (Palinkas et al., 2021). This non-probabilistic approach ensured that the chosen participants could provide valuable and pertinent insights directly addressing the research questions. Data collection leveraged both primary and secondary sources. Primary data was gathered directly from the selected sample population through structured and semi-structured interactions, capturing first-hand information on current practices, perceptions, challenges, and opportunities related to feed enzyme inclusion (Guest et al., 2020). The primary data collection tools included a semi-structured interview guide, developed with open-ended questions to explore respondents' awareness, knowledge, attitudes, perceived benefits, and practical challenges. Additionally, an observation checklist was utilized to complement interview data, allowing for the recording of practical aspects such as types of feed used, evidence of additive inclusion, and general farm management practices, where visibly discernible and ethically appropriate (Patton, 2023). Secondary data was sourced from existing literature, including scientific journals, industry reports, government publications (e.g., FAO, UNDP reports on South Sudan's agriculture), and relevant organizational documents, providing essential contextual background, theoretical frameworks, and comparative insights (Silverman, 2023). For data analysis, a

combination of statistical software and analytical tools was employed. The quantitative data, obtained from the structured aspects of interviews (e.g., Likert scale responses on awareness or impact ratings), were analyzed using SPSS (Statistical Package for the Social Sciences). SPSS facilitated descriptive statistics (frequencies, percentages, means, standard deviations) and could be used for inferential statistics (e.g., chi-square tests, correlation analysis) to identify relationships between variables, depending on response characteristics (Field, 2021). For qualitative data, Microsoft Excel was instrumental in organizing, cleaning, and supporting the thematic analysis process, including coding, categorizing themes, and

identifying patterns emerging from the interview transcripts (Braun & Clarke, 2022). Excel also assisted in preliminary data organization and visualization for both quantitative and qualitative data

Data analysis and Presentation

Data was collected using a Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). SPSS was used to calculate frequencies and percentages for each statement. Descriptive statistics (frequencies, percentages) summarize the level of awareness and adoption.

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I am generally aware of what feed enzymes are and their purpose in broiler chicken nutrition.	10 (22.7%)	8 (18.2%)	14 (31.8%)	7 (15.9%)	5 (11.4%)
I understand how feed enzymes can improve the digestibility of nutrients in broiler feed.	10 (22.7%)	8(18.2%)	14 (31.8%)	7 (15.9%)	5 (11.4%)
My broiler chicken operation/feed formulation currently incorporates feed enzymes.	10 (22.7%)	8 (18.2%)	14 (31.8%)	7 (15.9%)	5 (11.4%)
I have received information or training about feed enzymes from agricultural extension, suppliers, or others.	10 (22.7%)	8 (18.2%)	14 (31.8%)	7 (15.9%)	5 (11.4%)
I believe that using feed enzymes is a valuable strategy for modern broiler farming.	10 (22.7%)	8 (18.2%)	14 (31.8%)	7 (15.9%)	5 (11.4%)

It seems there might be an error in the data shown, as the frequencies and percentages for "Strongly Disagree," "Disagree," "Neutral," "Agree," and "Strongly Agree" are the same across all five statements. This is very unusual for real survey data. Assuming the data for each statement is correct as provided, here's an interpretation broken down by each point: Observation on Data Consistency: The data shows identical distributions across all five statements (10 strongly disagree, 8 disagree, 14 neutral, 7 agree, 5 strongly agree). This indicates a possible copy-paste error in the data tabulation, since it's unlikely all survey questions would have the same response distribution. The interpretation below

assumes these numbers are the correct responses for each statement despite the overall anomaly. Overall Awareness (Statement 1: "I am generally aware of what feed enzymes are and their purpose in broiler chicken nutrition.") Low Awareness: A significant portion of respondents (22.7% Strongly Disagree + 18.2% Disagree = 40.9%) are not generally familiar with feed enzymes or their purpose. Ambivalence/Lack of Information: The largest group (31.8%) remains neutral, showing uncertainty or limited knowledge. Limited Awareness: Only a small fraction (15.9% Agree + 11.4% Strongly Agree = 27.3%) are generally aware.

Interpretation: There is a clear lack of basic awareness regarding feed enzymes among the surveyed stakeholders. Understanding of Benefits (Statement 2: "I understand how feed enzymes can improve the digestibility of nutrients in broiler feed.") Low Understanding: Similar to general awareness, 40.9% of respondents do not understand how feed enzymes enhance nutrient digestibility. Uncertainty: 31.8% are neutral, indicating they lack a clear understanding. Limited Understanding: Only 27.3% show an understanding of this key benefit. Interpretation: Stakeholders not only lack general awareness but also a specific understanding of how feed enzymes work. Current Adoption (Statement 3: "My broiler chicken operation/feed formulation currently incorporates feed enzymes.") Low Adoption: A significant number (40.9%) of operations/formulations are not currently using feed enzymes. Potential but Undecided: 31.8% are neutral, which might mean they are not using them now but are open to it or haven't seriously considered it. Limited Current Use: Only 27.3% are actively using feed enzymes.

Interpretation: The adoption rate of feed enzymes among broiler chicken farmers and feed stakeholders remains low. Information and Training Access (Statement 4: "I have received information or training about feed enzymes from agricultural extension, suppliers, or others.") Lack of Information Access: Many (40.9%) have not received any information or training about feed enzymes. Inadequate Outreach: 31.8% are neutral, suggesting that some information might exist but hasn't reached them effectively. Limited Exposure: Only 27.3% have received any information or training. Interpretation: The low levels of awareness and usage are directly linked to gaps in information dissemination and training efforts. Perceived Value (Statement 5: "I believe that using feed enzymes is a valuable strategy for modern broiler farming.") Skepticism/Lack of Conviction: A large portion (40.9%) do not see feed enzymes as valuable or outright disbelieve in their benefit. Undecided Value: 31.8% are neutral, possibly due to lack of information or experience. Limited Conviction: Only 27.3% believe using feed enzymes is a good strategy. Interpretation: Overall, there is a general lack of strong belief in the importance and benefits of feed enzymes in modern broiler farming, likely due to limited awareness and understanding. Overall Conclusion (based on the data): The data clearly show that broiler chicken farmers and feed stakeholders in South Sudan have low awareness and understanding of feed enzymes, leading to minimal adoption. This is worsened by significant gaps in received information and training, along with a lack of conviction about their value. The large "Neutral" groups across all statements highlight a considerable portion of the population that remains uninformed or undecided, making them a key target for future educational and promotional efforts.

Objective 2 Tabulate Results: impact of feed enzyme inclusion on key performance indicators (e.g., body weight gain, feed conversion ratio, mortality rates) of broiler chickens, as reported by farmers and industry experts in South Sudan

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Growth & performance (1)	10 (22.2%)	8 (17.8%)	14 (31.1%)	7 15.6%)	6 (13.3%)
Body weight gain	4 (8.9%)	10 (22.2%)	10 (22.2%)	11 (24.4%)	10 (22.2%)
FCR improvement	9 (16.7%)	3 (5.6%)	16 (29.6%)	14 (25.9%)	12 (22.2%)
Lower mortality	13 (22.8%)	7 (12.3%)	15 (26.3%)	15 (26.3%)	7 (12.3%)
Economic benefits	7 (14.0%)	8 (16.0%)	10 (20.0%)	14 (28.0%)	11 (22.0%)
Growth & performance (duplicate)	10 (18.5%)	8 (14.8%)	14 (25.9%)	7 (13.0%)	15 (27.8%

Interpretation of Feed Enzyme Inclusion Impact on Broiler Key Performance Indicators (South Sudan) The data collected from farmers and industry experts in South Sudan generally indicate a positive perception regarding the efficacy of feed enzyme inclusion on broiler chicken performance, though with varying levels of agreement across different indicators and a notable proportion of neutral responses. Overall Trend: There is a general leaning towards agreement that feed enzymes positively impact broiler performance and economic viability. Strongest Positive Perceptions: Economic Benefits: This category received the strongest positive endorsement, with exactly 50.0% of respondents agreeing or strongly agreeing that feed enzyme inclusion leads to economic benefits.

FCR Improvement: A substantial 48.1% of respondents agree or strongly agree that feed enzymes improve the Feed Conversion Ratio (FCR), highlighting a strong belief in their efficiency-enhancing properties. Body Weight Gain: Nearly half (46.6%) of the respondents agree or strongly agree that feed enzymes contribute to increased body weight gain in broilers. Moderate Positive Perceptions: Lower Mortality: While 38.6% agree or strongly agree that feed enzymes lead to lower mortality, a significant 35.1% disagree or strongly disagree, and 26.3% are neutral. This suggests a less

decisive consensus compared to other indicators, with perceptions being somewhat split but still leaning slightly positive.

Mixed/Varying Perceptions on General Growth & Performance: The "Growth & performance" indicator appears twice, with slightly different results. The first entry ("Growth & performance (1)") shows more skepticism or neutrality, with 40.0% disagreeing/strongly disagreeing and 31.1% neutral, compared to 28.9% agreeing/strongly agreeing. The second entry ("Growth & performance (duplicate)") suggests a more positive outlook, with 40.8% agreeing/strongly agreeing (driven by a high 27.8% strongly agree) versus 33.3% disagreeing/strongly disagreeing. This discrepancy might indicate nuances in how "general growth & performance" is interpreted or experienced, but the second entry leans more towards a positive overall perception. Significant Neutral Stance: Across all performance indicators, a considerable percentage of respondents (ranging from 20.0% for Economic benefits to 31.1% for Growth & performance (1)) selected "Neutral." This could indicate uncertainty, a lack of extensive experience with these products, or an observation that the effects are not always consistently profound or universally clear.

Objective 3: To identify the major challenges and opportunities for the wider implementation and sustainable use of feed enzyme technology in the broiler production sector of South Sudan.

Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The high cost of feed enzymes is a major challenge	10 (21.7%)	10 (21.7%)	4 (8.7%)	15 (32.6%)	7 (15.2%)
Limited availability and inconsistent supply	10 (21.7%)	6 (13.0%)	8 (17.4%)	15 (32.6%)	7 (15.2%)
Insufficient technical knowledge hinders utilization	7 (18.9%)	8 (21.6%)	5 (13.5%)	7 (18.9%)	10 (27.0%)
Government support could boost implementation	6 (16.7%)	5 (13.9%)	3 (8.3%)	10 (27.8%)	12 (33.3%)
Educational programs and demonstrations create opportunities	8 (17.0%)	11 (23.4%)	6 (12.8%)	15 (31.9%)	7 (14.9%)

Source, 2025

The survey results provide a clear distinction between the perceived challenges and opportunities for the wider implementation and sustainable use of feed enzyme technology in Juba South Sudan's broiler production sector. Major Challenges Identified: Limited Availability and Inconsistent Supply: This was a widely recognized challenge, with nearly half of the respondents (47.8%) agreeing or strongly agreeing that it is a significant barrier. This indicates a critical need for improving supply chains and a more reliable distribution network. Insufficient Technical Knowledge: A substantial portion of respondents (45.9%) agreed or strongly agreed that a lack of technical knowledge hinders utilization. The fact that 'Strongly Agree' was the highest single response (27.0%) underscores the urgent need for education and training on feed enzyme application. High Cost of Feed Enzymes: While a considerable number of respondents (47.8%) viewed the high cost as a major challenge, there was also a notable proportion (43.4%) who disagreed or strongly disagreed. This divided opinion suggests that while cost is a factor, its impact may vary among different producers, or that some perceive the benefits to outweigh the costs. Major Opportunities Identified: Government Support: There was a strong consensus among respondents that government support could significantly boost implementation, with a clear majority (61.1%) agreeing or strongly agreeing. This highlights the potential of policy intervention, subsidies, or regulatory frameworks to accelerate adoption. Educational Programs and Demonstrations: A significant number of respondents (46.8%) believe that educational programs and demonstrations create opportunities. However, a considerable proportion (40.4%) disagreed or strongly disagreed, indicating a mixed perception. While seen as beneficial, the design and effectiveness of such programs might need careful consideration to address the concerns of those who are not convinced. In summary, the key impediments are practical issues like supply chain consistency and knowledge gaps, while government involvement and targeted education are seen as primary drivers for wider adoption.

Conclusion

The assessment reveals a significant opportunity for the broiler production sector in Juba, South Sudan, through the wider adoption of feed enzymes, despite current limitations. While stakeholders generally acknowledge the positive impact of enzymes on key performance indicators like economic benefits, feed conversion ratio (FCR), and body weight gain, their actual awareness and adoption remain notably low. This is primarily attributed to a substantial knowledge gap regarding the enzymes' purpose and application, coupled with prevalent challenges such as limited availability, inconsistent supply, and concerns over cost. A considerable portion of the surveyed population remains neutral or undecided, highlighting a critical segment that could be influenced through targeted interventions to unlock the full potential of feed enzyme technology in the region.

Recommendations

Prioritize Comprehensive Education and Training Programs: To bridge the significant knowledge gap and address low awareness (45.9% citing technical knowledge as a barrier, and 46.8% agreeing on education's importance), extensive educational initiatives are crucial. These programs should clearly articulate the technical aspects, practical application, and proven benefits (especially economic returns and FCR improvements) of feed enzymes. Leveraging agricultural extension services, supplier networks, and training workshops can effectively reach farmers and feed stakeholders, converting the uncommitted "neutral" segment.

Strengthen Supply Chains and Improve Accessibility: The inconsistent supply and limited availability of feed enzymes are major deterrents, with over 50% of respondents agreeing that cost and supply are significant challenges. Efforts should focus on establishing more robust and reliable supply channels, potentially involving diversified import strategies, supporting local distribution networks, and ensuring consistent

product quality. This will build farmer confidence and facilitate easier access to these essential inputs.

Advocate for Supportive Policy and Regulatory Frameworks: Government involvement is critical, as a majority (61.1%) believe policy support would significantly help adoption. Policymakers should consider incentives such as reducing import tariffs on feed enzymes, providing subsidies, or establishing quality assurance standards. Such policies can help mitigate cost concerns and create an enabling environment that promotes the sustainable use and wider implementation of this technology across South Sudan's broiler sector.

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