Determinants of Low Productivity in Improved Crossbred chickens: A Case Study from Korogwe District of the Tanga region in Tanzania

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ABSTRACT

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| This study investigated the factors limiting the productivity of improved crossbred chickens in Magunga Ward, Korogwe Town Council, Tanzania. Poultry farming plays significant role in Tanzania's economy, and 96% of chickens are indigenous eco-types raised in smallholder systems, primarily contributed by rural areas. Despite the sector's potential to significantly boost GDP and reduce the meat deficit, as highlighted by the Tanzania Livestock Master Plan (TLMP) and the Agricultural Sector Development Program Phase II (ASDP II), mere challenges persist. These include limited access to quality feed, veterinary services, diseases prevalent (Newcastle and Gumboro), inadequate knowledge, technical support, and insufficient capital. The study employed a cross-sectional survey design, randomly sampling 40 poultry farmers (70% female) in Magunga Ward. Data was analyzed using SPSS revealed that low production is primarily attributed to diseases (37.5%), inadequate farmer knowledge (30%), poor management (25%), and substandard housing (7.5%). High feed costs (52.5%) and lack of capital (32.5%) further constrained the productivity. While farmers perceive improved crossbred chickens positively, these findings underscore the need for comprehensive interventions focusing on disease control, improved farmer training, enhanced infrastructure, and increased access to resources to boost productivity and improve livelihoods in Magunga Ward. |

*Keywords: Crossbred chickens, Management practices, Magunga-Korogwe-Tanzania, Smallholder poultry farming.*

1. INTRODUCTION

This study investigated the factors contributing to low productivity in improved crossbred chickens within Magunga Ward, Korogwe Town Council, Tanga Region, Tanzania. Poultry farming constitutes a significant economic activity in Tanzania, boasting a national chicken population of 43.7 million and a 5.1% annual growth rate [1]. However, approximately 96% of these chickens are indigenous breeds, raised under diverse traditional and commercial systems [2]. Commercial production, primarily utilizing improved layer and broiler ecotypes, is concentrated in urban and peri-urban areas. In contrast, traditional smallholder systems, prevalent in rural areas, involve smaller flocks of local ecotypes, serving vital roles in income generation, food security, and employment, particularly for women and children [3]. These systems supply the majority of poultry meat and eggs consumed in rural areas and approximately 20% in urban areas. The demand for poultry products is rapidly increasing due to population growth and rising purchasing power [4].

Within Tanzania's 35% subsistence farming households, 53% engage in poultry farming [5]. The Tanzania Livestock Master Plan (TLMP) highlights the poultry's potential to bridge the gap between meat production and consumption. Strategic investment in the poultry sector, encompassing quality control, disease management (Newcastle and Gumboro diseases), enhanced extension services, and private sector mobilization for chick and feed production, could generate a 35% surplus of white meat for export, significantly boosting foreign currency earnings. This investment could increase the poultry industry's contribution to GDP by 182%, from 256 billion to 723 billion shillings, substantially reducing the meat production deficit [6]. The Agricultural Sector Development Program Phase II (ASDP II) provides the framework for financing, implementing, and monitoring these strategic initiatives, aiming to improve livestock productivity, stimulate investment in processing industries, and expand domestic and international trade. The anticipated outcomes include enhanced market access, increased employment, expanded revenue streams, and improved food security and nutrition [3].

Despite this potential, the development of commercial chicken production in Tanzania faces significant hurdles. These include limited access to quality feed and medicines, diseases prevalent, inadequate technical support, low genetic potential of local breeds, constraints on labor, market access, lack of capital, deficiencies in extension services and equipment, and insufficient knowledge among farmers [7, 34, 35]. Farmers often resort to indiscriminate use of chemotherapeutic agents to enhance growth, treatment of diseases, and mitigate losses (Nonga et al., 2010). Inadequate extension services and animal health systems lead to self-medication by farmers, often resulting in incorrect dosages and antimicrobial residues in poultry products [8].

Poultry farming is deeply embedded in Tanzania's rural economy, with approximately 35 million chickens, 33 million of which are indigenous breeds predominantly raised in rural areas [9]. Most are reared extensively or semi-intensively. Indigenous breeds, comprising over 70% of the national flock, are the mainstay of the traditional system, supplying most rural poultry meat and eggs and about 20% of urban consumption [10]. Improved indigenous chicken production, often involving crossbreeding with exotic males aimed at exploiting the resulting heterosis of the produced crossbreds, is more common in urban and peri-urban areas under semi-intensive and intensive systems [11]. These systems vary from extensive free-range practices in rural areas with minimal input for housing, feeding, and healthcare [11, 12] to semi-extensive systems in rural and peri-urban areas utilizing local and improved breeds and inputs.

In Korogwe Town Council, indigenous chicken farming practices often involve birds sharing living quarters with humans or being housed in substandard structures, leading to reduced productivity. To address this, the council, in collaboration with the Magunga ward community, initiated an improved indigenous chicken project under the Agricultural Sector Development Program (ASDP) in 2007-2008. This study aimed to builds upon existing research on antimicrobial use in poultry [4] and the effects of season and farming systems on poultry performance [13], focusing specifically on the factors limiting improved crossbred chickens’ production in Magunga Ward, Korogwe Town Council, a gap previously unaddressed in the literature.

2. materialS and methods

Study Area

This study was conducted in Magunga Ward, Korogwe Town Council, Tanga Region, characterized by diverse topography and soil types, including loamy, sandy, and clay soils. The area encompasses mountain zones, low wetlands, semi-arid regions, and an irrigation zone along the Pangani River. The ward comprises Masuguru and Kwasemangube villages, where farming activities include maize, beans, and cassava cultivation, alongside livestock rearing (cattle, goats, sheep, pigs, and chickens).

Research Design

This study employed a cross-sectional survey design, enabling efficient data collection within a short timeframe due to limited resources. Cross-sectional studies offer a cost-effective and convenient alternative to other research designs [14], conserving both time and resources, particularly where resource availability might influence outcomes [15]. This approach ensured the study was both reasonably inexpensive and completed within a short timeframe.

Study Population

This study's population, defined as a group sharing relevant characteristics [16, 17, 18, 19], comprised the residents of Magunga Ward, Korogwe Town Council. This selection was based on the expectation that these individuals possessed valuable insights into improved crossbred chickens’ production. Both men and women were included as they share responsibility for raising these chickens.

Sampling Frame and Method

Forty respondents (men and women) were randomly selected from Magunga Ward to ensure representative data collection [20, 21]. This simple random sampling technique, applied at the individual level, yielded a sample size suitable for acquiring reliable information on improved crossbred chickens rearing practices within the ward, minimizing sampling bias.

Data Collection Method

This study used a primary data collection method, employing questionnaires and face-to-face interviews to gather first-hand information on factors affecting improved crossbred chickens’ production in Magunga Ward [17]. A simple random sample of forty poultry farmers completed questionnaires containing both open-ended and closed-ended questions. Open-ended questions allowed for richer qualitative data, while closed-ended questions facilitated efficient quantitative analysis [22]. This mixed-methods approach ensured comprehensive data collection, balancing detailed respondent perspectives with structured, easily analyzable information.

Data Validity and Reliability

The study ensured data validity—accurate measurement of the intended constructs [23]—and reliability—consistent results across measurements [24, 25]—through rigorous survey design and consistent procedures throughout data collection, transcription, and analysis.

Data Processing and Analysis

Quantitative data were analyzed using SPSS version 20 software, employing descriptive statistics (frequencies, percentages, and means) to analyze numerical data categorized by gender, age, marital status, and education level. Qualitative data were analyzed using Excel. Data processing involved editing, coding, classification, and tabulation to facilitate analysis [17]. SPSS's efficiency enabled rapid analysis of large datasets, and results were presented in tables, graphs, and charts, reflecting demographic characteristics. Descriptive statistics (frequencies, percentages, and means) were used to interpret relationships and comparisons between variables.

3. results and discussion

Respondents demographic details

The study comprised 40 respondents (70% female, 30% male) aged 32–70 years (mean 47 years), with most (77.5%) falling within the 32–50-year age range. The majority (95%) were married, suggesting a focus on household income generation. Educational attainment was high, with 97.5% completing primary education, indicating a potential correlation between education and the adoption of modern farming techniques. These demographic characteristics provided valuable context for interpreting the study's findings (see Table 1).

Factors causing low production of improved crossbred chickens

Several interconnected factors contribute to low improved crossbred chicken production in Magunga Ward. Our findings reveal that diseases (37.5%), inadequate farmer knowledge of feeding and best practices (30%), poor management (25%), and substandard housing (7.5%) are significant challenges. The high disease prevalence, exacerbated by limited veterinary services, results in substantial bird mortality. Poor feeding and management practices, combined with inadequate housing, further reduce production levels. These findings highlight the urgent need for interventions focused on disease control, farmer training, and improved poultry infrastructure to increase production (see Table 2).

Farmer’s perceptions toward improved crossbred chickens’ production

Farmers perceive improved crossbred chickens positively, valuing their income-generating potential, savings function, and consistent cash flow. This financial stability strengthens their resilience to challenges and offers significant opportunities for profitable poultry farming (see Table 3).

Challenges Faced by Farmers in Chicken Production

Poultry farmers in this study faced significant challenges, most notably high feed costs (52.5%), followed by capital limitations (32.5%), inadequate extension services (12.5%), and insufficient space (2.5%). The high cost of nutritious feed severely impacts profitability, hindering farmers' ability to generate sufficient income (see Table 4).

This study examined the factors influencing productivity of improved crossbred chickens in Magunga ward, considering demographic characteristics, disease prevalence, farmer knowledge and practices, and resource availability.

Demographic data provided valuable context, revealing disparities in farmers' views, perceptions, knowledge, skills, and practices regarding poultry farming [26]. As [27] demonstrated, analyzing age, experience, and education levels offers a broader understanding of respondent characteristics, enhancing the validity and reliability of the collected information. This study underscores the importance of including demographic details to better understand the nature of the poultry farming population.

Poultry diseases pose a significant constraint to livestock productivity [6], resulting in direct costs from animal deaths, reduced productivity, and disease control measures. Viral infections like Newcastle disease and Infectious Bursal Disease (Gumboro) are leading causes of mortality, despite vaccination efforts. Vaccine failure and the involvement of unqualified individuals in disease treatment contribute to this issue. The lack of readily available and affordable veterinary services exacerbates the problem, leading to continuous losses of both young and adult chickens. This lack of access, coupled with high veterinary costs, discourages farmers from investing in poultry production due to the inherent risks of disease outbreaks and mortality [28].

Farmer experience plays a crucial role in effective poultry management and the adoption of new technologies [7]. Experienced farmers are better equipped to utilize appropriate feeding techniques and embrace modern farming practices. However, in Magunga ward, reliance on maize bran as the primary feed source, while sufficient in quantity, lacks the essential nutrients for optimal growth, maintenance, and production, resulting in lower yields. Furthermore, inadequate poultry housing lacking proper ventilation, lighting, and disinfection contributes to poor bird health and survival. Although farmers provide feeders and water drinkers, the overall management practices fall short of optimal standards.

Improved crossbred chickens offer several economic advantages, including increased income, savings potential, and a continuous cash flow, strengthening farmers' financial resilience [6]. Chickens are a vital source of protein, playing a significant role in the national food system and socio-cultural activities, contributing to family income and employment opportunities. Indigenous chickens supply 100% of rural poultry meat needs and 20% of urban demand [6], playing a vital role in reducing malnutrition, poverty and ensuring food security [29]. This highlights the importance of developing strategies to optimize resource use and increase production efficiency [7]. Understanding the production systems, opportunities, and constraints is crucial for changing attitudes and promoting successful crossbred chickens’ development programs that benefit rural communities [30]. The poultry industry's potential to enhance food security, nutrition, and its contribution to GDP, further emphasizes the need for improvement [6].

Several factors limit the productivity of indigenous chickens. These include: lack of capital: Insufficient capital is a major constraint, particularly for low-income farmers, hindering efficient operation and productivity [6]; low genetic potential for production traits and frequent disease outbreaks, especially Newcastle disease, limit the productivity [31, 32]. While crossbreeding could improve performance, concerns about conserving indigenous genetic resources present a challenge [7, 33]; and Inadequate Infrastructure: The lack of proper poultry housing and modern infrastructure increases disease incidence leading to reduced productivity [6]. Many chickens are left to scavenge, leading to disease transmission and poor production. Thus, improving crossbred chickens’ production in Magunga ward requires a multi-faceted approach addressing disease control, enhancing farmer knowledge, improving access to resources, and strengthening infrastructure. Addressing these challenges will contribute to improved food security, economic empowerment, and overall community well-being.

4. Conclusion

The study concluded that poultry diseases, particularly Newcastle disease and Gumboro, significantly hinder poultry productivity, causing substantial economic losses through mortality and reduced output. Vaccine failure and reliance on unqualified practitioners exacerbate the problem, leading to farmer reluctance to invest due to the high risk of disease outbreaks. Furthermore, the study signifies the importance of knowledge and understanding of poultry production systems in changing farmers' attitudes. Crossbred chickens’ development programs can benefit rural communities by improving indigenous chicken rearing practices. Finally, the study emphasizes the critical role of capital in establishing and maintaining successful poultry farms. The limited access to capital among low-income farmers in Tanzania poses a major constraint to efficient and productive poultry farming. The government should prioritize providing extension services, training programs, and farmer support networks to enhance poultry production. This should be coupled with a comprehensive Newcastle Disease vaccination program, improved feeding and rearing conditions, and better hygiene practices to minimize chick mortality and maximize the benefits of crossbreeding programs for genetic improvement.

**Table 1: Respondents demographic details (n=40)**

|  |  |  |
| --- | --- | --- |
| Feature | Frequency | Percent. |
| Sex  Male | 12 | 30.0 |
| Female | 28 | 70.0 |
| **Total** | **40** | **100.0** |
| Age (years) |  |  |
| 32-40 | 14 | 35.0 |
| 41-50 | 17 | 42.5 |
| 51-60 | 1 | 2.5 |
| 61-70 | 8 | 20.0 |
| **Total** | **40** | **100** |
| Marital status |  |  |
| Single | 1 | 2.5 |
| Married  Divorced  **Total**  Education level  Primary education | 38  1  **40**  39 | 95.0  2.5  **100**  97.5 |
| No schooling | 1 | 2.5 |
| **Total** | **40** | **100** |

**Table 2: Factors causing low production of improved crossbred chickens**

|  |  |  |
| --- | --- | --- |
| **Factors causing low production** | **Frequency** | **Percent** |
| Diseases, | 15 | 37.5 |
| Farmer’s experiences in feeding | 12 | 30 |
| Poor management | 10 | 25 |
| Poor poultry houses. | 3 | 7.5 |
| **Total** | **40** | **100.0** |

**Table 3: Farmer’s perceptions toward improved indigenous chicken’s production**

|  |  |  |
| --- | --- | --- |
| Household responsibilities in | chicken rearing |  |
| Father | 10 | 25.0 |
| Mother | 29 | 72.5 |
| All | 1 | 2.5 |
| Total | **40** | 100 |
| Benefit from chicken production |  |  |
| Yes | 28 | 70.0 |
| No | 12 | 30.0 |
| Total | **40** | 100 |
| Reasons for benefiting |  |  |
| Food | 11 | 27.5 |
| School fees | 6 | 15.0 |
| Covering small home needs | 10 | 25.0 |
| Buying chicken feed | 1 | 2.5 |
| Total | **28** | 70 |
| Reasons for not benefiting |  |  |
| Death when still young | 8 | 20.0 |
| No increase in production | 1 | 2.5 |
| Low production but high cost of production | 3  12 | 7.5  30 |
| Total | **40** | 100 |

**Table 4 Challenges faced by farmers in chicken production**

|  |  |  |
| --- | --- | --- |
| **Challenges faced by farmers** | **Frequency** | **Percent** |
| Lack of capital | 13 | 32.5 |
| High cost of animal feeds | 21 | 52.5 |
| Lack of extension services | 5 | 12.5 |
| In adequate area for production | 1 | 2.5 |
| **Total** | **40** | **100** |

Ethical approval

Research Ethical Clearance was obtained from the Tanzania Livestock Research Institute.

**Disclaimer (Artificial intelligence)**

Author(s) hereby declare that no generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

References

Aboe, P.A.T., Boa, A, K., Okantah, S.A., Dorward, P.T., Bryant, M.J. (2006). Free – range village on the Accra Plains, Ghana: Their contribution to households. Trop Aim Health Prod.<https://link.springer.com/article/10.1007/s11250-006-4357-9>.

Amoia, C. F., Hakizimana, J. N., Duggal, N. K., Chengula, A. A., Rohaim, M. A., Munir, M., ... & Misinzo, G. (2023). Genetic diversity of Newcastle Disease virus involved in the 2021 outbreaks in backyard poultry farms in Tanzania. Veterinary Sciences, 10(7), 477.

Bessei, W. (1988). Poultry production and extension in developing countries. In Proceedings 18th World Poultry Congress, Nagoya. Japan.<https://www.researchgate.net/publication/287058929_Methods_and_strategies_for_training_and_extensionin_family_poultry_production>

Burns, N., & Groves, S. (2001). The practice of nursing research: conduct, critique and utilization (4th ed). W.B. Saunders: Philadephia, Pennsylvania, USA.

Christensen, L. B., Johnson, R. B., & Turner, L. A. (2014). Research methods, design, and analysis (12th ed.). Boston, MA: Pearson.

Clark-carter, L. D. (1997). Doing qualitative and qualitative psychological research from design to report. East Sussex: Psychological Press Ltd.

Cohen, L., Manion, L., & Morrison, K. (2018). Research methods in education. 8Th Edition Routledge Publishers.

E. H. Goromela1, R. P. Kwakkel, M. W. A. Verstegen and A. M. Katule (2008). Effect of season and farming system on the quantity and nutritional quality of scavengeable feed resources and performance of village poultry in central Tanzania. Journal of Cell and Animal Biology Vol. 2 (3), pp. 063-071, March, 2008 Available online at http://www.academicjournals.org/JCAB ISSN 1996-0867 © 2007 Academic Journals.

Final Report on Waste Management Plan (2022) for Public Disclosure Authorized Public Disclosure Authorized Public Disclosure Authorized livestock productivity and resilience support project (lpres) <https://documents1.worldbank.org/curated/en/597721542693464290/pdf/final-waste-management-plan-report-for-lpres-cleared.pdf>.

H.E. Nonga, K.H. Sungura and H.A. Ngowi (2009). Assessment of veterinary drug use and determination of antimicrobial residues in broiler chicken meat in Urban district, Zanzibar, Tanzania. https://www.suaire.sua.ac.tz/server/api/core/bitstreams/fccae106-1ae7-460b-b0a9-a00de760707c/content.

Halima, H., Neser, F. W. C., Van Marle-Koster, E., & De Kock, A. (2007). Village-based crossbred chickens production system in north-west Ethiopia. Tropical Animal Health and Production.<https://pubmed.ncbi.nlm.nih.gov/17969713/>

HE Nonga, M Mariki, ED Karimuribo, RH Mdegela (2010). Assessment of antimicrobial usage and antimicrobial residues in broiler chickens in Morogoro Municipality, Tanzania. <https://scholar.google.com/citations?view_op=view_citation&hl=en&user=G57nT1gAAAAJ&citation_for_view=G57nT1gAAAAJ:qjMakFHDy7sC>.

Katule, A. M. (1991). Poultry production: Genetic improvement of fowl for small scale producers. Entwicklung und laendlicherRaum.<https://www.researchgate.net/publication/251879546_A_century_of_poultry_genetics>

Kosgey, I.S. (2004) Breeding Objectives and Breeding Strategies for Small Ruminants in the Tropics. PhD Thesis, Wageningen University, the Netherlands, 272 p.<https://www.scirp.org/reference/referencespapers?referenceid=2727259>.

Kothari, C.R. (2004) Research Methodology: Methods and Techniques (2ed) New Age International Publisher.

Kumar, R. (2019). *Research methodology*: A step-by-step guide for beginners. Sage Publications Limited.

Lawrence, P. (1998). Ecotypes and Natural Disease Resistance among scavenging indigenous chickens of Tanzania. Doctoral dissertation, Royal Veterinary and Agricultural University, Department of Veterinary Microbiology.<https://www.bing.com/images/search?q=lawrence+p+1998+ecotypes+and+natural+disease+resistance+among+scavenging+local+chickens+of+tanzania+doctoral+disse>

Lourdes B. (Ed). 1982. Women and development: The Sexual Division of Labor in `Rural Societies. United Nations. New York, USA.

Lwelamira, J. (2007). Prospects for improving performance among two indigenous chicken ecotypes of Tanzania through selection. Unpublished PhD thesis, Sokoine University of Agriculture, Morogoro.<http://www.lrrd.org/lrrd20/11/lwel20171.htm>.

MAFAP (2013). Revue des polities’ agricoles etalimentaires au Burkina Faso. Série rapport pays SPAAA,FAO.https://www.fao.org/fileadmin/templates/mafap/documents/Burkina\_Faso.

MAFC (2003). Poultry and pig production. Vol. I. Ministry of Agriculture and Food Security. Department of training institutes (Instructional materials development unit/ASPS).<https://www.sciencedirect.com/science/article/pii/S2211912416301043>

Maninder, S. S. (2016). Methodology Series Module 3: Cross-sectional Studies. Article in Indian Journal of Dermatology -DOI: 10.4103/0019-5154.182410

MLD (2006).Investment opportunities in the livestock industry Tanzania.<https://www.tva.or.tz/images/Livetock_Policy_2006.pdf>.

Msami, A. (2007). Poultry sector country review, Tanzania<https://www.researchgate.net/publication/361040037_Linear_Programming_Optimization_Model_of_Broilers_Poultry_feeds_for_Local_entrepreneurs_in_Tanzania_A_case_study_of_Morogoro_Municipality>.

Msoffe, P. L. M. (2003). Diversity among the indigenous chicken ecotypes in Tanzania. Unpublished PhD thesis, Sokoine University of Agriculture, Morogoro.<https://www.suaire.sua.ac.tz/server/api/core/bitstreams/f2e9a0cd-fc9c-4787-8709-826e223c22cd/content>

Muchadeyi, F. C., Wollny, C. B. A., Eding, H., Weigend, S., Makuza, S. M., &Simianer, H. (2007). Variation in village chicken production systems among agro-ecological zones of Zimbabwe. Tropical animal health and production.<https://www.academia.edu/23962656/Variation_in_village_chicken_production_systems_among_agro_ecological_zones_of_Zimbabwe>.

Mutayoba, S. K, Mwalusanya, N. A., Katule, A. M., Mtambo, M. M. A., Olsen, J. E., &Minga, U. M. (2002). Productivity of indigenous chickens under village management conditions. Tropical Animal Health and Production.<https://pubmed.ncbi.nlm.nih.gov/12379059/>

Opie, C. (2019). Research procedures. Getting Started in Your Educational Research: Design, Data Production and Analysis, 159.

Permin, A., and G. Pedersen. (2002). "The need for a holistic view on disease problems in free-range chickens." FAO/IAEA. Characteristics and parameters of family poultry production in Africa. Vienna.<https://www.researchgate.net/publication/237254262_the_need_for_a_holistic_view_on_disease_problems_in_free-range_chickens>.

Raudeliuniene, J. (2018). Basic Research Methods. Modernizing the Academic Teaching and Research Environment: Methodologies and Cases in Business Research, 47.

Sekeroglu, A., & Aksimsek, S. D. (2009). Village chicken production in Turkey: Tokat province example. Tropical Animal Health and Production. <https://www.researchgate.net/publication/5406881_Village_chicken_production_in_Turkey_Tokat_province_example>.

Shaughnessy J.J, Zechmeister E.B and Zechmeister J.S. (2000). Research methods in psychology (5th ed) New York. Mc Craw Hill.

Taherdoost, H. (2016). Validity and Reliability of the Research Instrument: How to test the validation of questionnaire/survey in research. International Journal of Academic Research Management (IJARM). Vol.5, No. 3. Retrieved from: http://doi.org/ 10.2139/ssrn.3205040/10/12/2020/10:20pm

Tarsi, K., & Tuff, T. (2012). Introduction to Population Demographics. Nature of education knowledge. Retrieved from: https://www.researchgate.net/ 290851981. 69i57j0i3017.12190 j0j7.

URT (2022) LIVESTOCK SECTOR TRANSFORMATION PLAN (LSTP) 2022/23 - 2026/27. <https://www.mifugouvuvi.go.tz/uploads/publications/sw1675840376>.

Ezekiel, U. J., & Hilary, U. U.-A. (2019). Effect of Strain on External and Internal Egg Parameters of Exotic, Indigenous Chicken and Crossbreds. Current Journal of Applied Science and Technology, 38(6), 1–7. https://doi.org/10.9734/cjast/2019/v38i630429

Sarma M, Talukdar A, Islam R, Phookan A, Deka A. (2025) Study on Some Important Morphometric Traits of Kamrupa Chicken. J. Sci. Res. Rep. 31(4):327-33: https://journaljsrr.com/index.php/JSRR/article/view/2953