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Predictive Power and Enhancing Body Weight Estimation in Sheep: A Review

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Abstract

Sheep production is an important element to many people's livelihoods that are living in rural areas and are involved with small-scale farming. In addition to providing a steady source of income for those involved with sheep, it also supplies them with a consistent source of meat, milk, and cultural value. The purpose of this study was to combine research about estimating the live body weight of sheep through various linear measures. It demonstrates the importance of body weight in animal performance as well as assesses five of the most commonly used morphometric measurements (heart girth, withers height, body length, sternum height, and rump height), which were found to be effective indicators that can easily be measured. In Nigeria, where the contribution of livestock to both food availability and rural economic development is very high, there is an absolute necessity for establishing with precision animal performance indicators or attributes including body conformation and carcass quality characteristics; so that the best possible decisions can be made regarding selection and mating, nutritional management, and marketing of animals. The use of linear body measurements represents one of the most convenient methods due to their rapid application, low cost, and suitability in developing countries where weighing equipment is often unavailable. These characteristics have great value in terms of describing the morphological makeup, the potential for growth, and the developmental characteristics of the animals; which will result in higher levels of meat

production from the small holder farmers producing native breeds such as the West African Dwarf (WAD) sheep

Keywords: Prediction, Morphometry, West African Dwarf sheep, Body Weight

1.0 Introduction

Indigenous sheep breeds have a major function within the livestock system of developing countries such as Nigeria and their contribution towards income from the household, employment opportunities, food availability, and social cultural functions is substantial (Afolayan *et al*., 2006). In addition to this, indigenous sheep breeds play an important role in small-scale farmers' and communal farming systems by providing them with access to meat and skin products that may be used for economic purposes (Atta *et al.* 2024). This is similarly true for other small ruminants, such as the West African Dwarf (WAD) goat, which is widely distributed across Nigeria's rain forest zone and is valued for its capacity to produce meat, milk, skin, and hair while resisting trypanosomes and intestinal worms (Okon *et al.*, 2023). The increasing demand for animal protein has further heightened the need for improved sheep productivity and efficient management practices (Camacho-Pérez *et al.*, 2022).

Body weight is probably the best indicator of an animal's overall fitness for the purpose of evaluating them economically. It can be used to assess how fast they are growing and what their feed efficiency is as well as help with breeding decisions, managing the animal's health and its price at the market (Sam et al., 2023: Musa et al., 2012; Atta et al., 2024). In the broiler industry, for example, feed efficiency is a major criterion for defining performance because feed can represent roughly 75% of total production costs. Research indicates that live weight and weight gain are strongly correlated with how efficiently an animal utilizes its feed (Alphonsus et al., 2012). The accurate measurement of body weight will allow the farmer to create a suitable diet, provide the right dosage of medications and choose better quality breeding animals (Atta *et al*., 2024).

Despite its importance, direct measurement of body weight remains difficult in many rural production systems due to the unavailability or high cost of weighing scales (Birteeb *et al*., 2012). Transportation of scales to remote locations may be impractical, while handling animals during weighing can increase stress and injury risks (Atta *et al*., 2024). Consequently, many farmers continue to estimate body weight visually, a practice that is often subjective and prone to substantial errors (Birteeb *et al*., 2012). These challenges have stimulated research into alternative methods for estimating body weight using easily measurable physical characteristics (Musa *et al*., 2012).

Linear body measurements have emerged as reliable and cost-effective predictors of body weight in livestock species (Afolayan *et al*., 2006; Musa *et al*., 2012). Measurements such as heart girth, body length, height at withers, rump height, and chest depth are strongly associated with live body weight because they reflect skeletal growth, muscular development, and body conformation

(Musa *et al*., 2012). Similarly, in rabbits, live body weight has been established as a reliable indicator for carcass traits, such as dress weight and loin weight, allowing farmers to predict income and fix prices accurately before slaughter (Sam *et al*., 2020). Ultimately, the high level of dependency between these physical characteristics means that any improvement in one trait often elicits a concomitant positive effect on the others (Alphonsus *et al*., 2012).

The predictive ability of morphometric traits is based on allometric relationships between body dimensions and overall body mass (Musa *et al*., 2012). As animals grow, changes in skeletal structure and body volume are reflected in measurable external dimensions, allowing researchers to develop mathematical equations for estimating live weight (Atta *et al*., 2024). Heart girth has consistently been identified as the most reliable single predictor of body weight because it captures variations in thoracic development, musculature, and fat deposition (Afolayan *et al*., 2006; Atta *et al*., 2024). Studies have frequently reported strong positive correlations between heart girth and body weight, highlighting its usefulness in practical livestock management (Musa *et al*., 2012).

The application of morphometric measurements for weight prediction is not limited to sheep. Similar approaches have been successfully employed in poultry production, where body dimensions have demonstrated strong relationships with body weight (Sam and Udo, 2025). The use of body measurements as predictors of growth performance in poultry supports the broader concept that external morphometric traits can serve as reliable indicators of productive potential across livestock species (Sam *et al*., 2025; Udo *et al*., 2025). Such findings reinforce the value of morphometric evaluation as a practical tool for animal selection, performance assessment, and management under resource limited conditions.

Recent advances in statistical modeling have further improved the accuracy of body weight prediction equations (Atta *et al*., 2024). Multiple regression models that incorporate two or more body measurements generally provide greater predictive accuracy than models based on a single trait (Sam *et al*., 2025; Birteeb *et al*., 2012). Furthermore, emerging technologies such as computer vision systems, image analysis, machine learning, and automated monitoring tools are expanding opportunities for weight estimation in livestock enterprises (Camacho-Pérez *et al*., 2022). Nevertheless, conventional morphometric measurements remain the most accessible and affordable approach for farmers in developing countries where technological resources may be limited (Sam *et al*., 2026; Atta *et al*., 2024).

Given the importance of accurate body weight estimation for productivity improvement and sustainable livestock management, there is a need to synthesize available information on the use of growth and morphometric traits as predictors of body weight in sheep (Afolayan *et al*., 2006; Atta *et al*., 2024). Therefore, this review examines published literature on body weight prediction using linear body measurements, with particular emphasis on indigenous sheep breeds and their relevance to sheep production systems in Nigeria.

2.0 Importance of Body Weight in Sheep Production

Body weight serves as a key indicator of growth rate, productivity, and health status in sheep. It represents the total accumulation of muscle, fat, bone, and other tissues, making it a standard measure for assessing an animal's developmental stage and physiological condition (Akpa *et al*., 2011). As one of the most economically valuable traits in sheep farming, body weight directly affects breeding choices, market price, feed conversion efficiency, and reproductive success (Lakew *et al*., 2017; Kumar *et al*., 2017).

Reliable body weight data is vital for sound flock management. Farmers use it to track growth performance, identify high-performing animals, and select superior breeding stock for genetic improvement (Shirzeyli *et al*., 2013). It also guides precise feeding regimes to meet nutritional needs while avoiding overfeeding or underfeeding (Asefa *et al*., 2017). In addition, accurate weight information is critical for determining correct dosages of medications, vaccines, and anthelmintics, thereby safeguarding animal welfare and productivity (Chitra *et al*., 2012).

In many developing nations such as Nigeria, smallholder farmers often lack access to weighing scales. In such settings, the capacity to estimate body weight using body measurements becomes highly practical. Research has consistently shown strong links between live weight and various linear body dimensions, allowing reliable indirect estimation (Sowande and Sobola, 2008; Sam *et al*., 2023). These relationships are particularly useful for indigenous breeds like the West African Dwarf sheep, where morphometric traits can effectively indicate growth potential and productivity (Sam *et al*., 2023).

2.1 Value of Morphometric Traits for Predicting Body Weight

Morphometric or linear body measurements offer valuable insights into the structural development and conformation of sheep. They provide a simple, low-cost method for estimating live weight, especially in rural areas where direct weighing is challenging (Sandeep *et al*., 2017).

Traits such as heart girth, body length, withers height, rump height, and sternum height reflect skeletal size, muscle development, and overall body capacity (Agamy *et al*., 2015). Multiple studies have reported strong positive correlations between these measurements and body weight, confirming their usefulness as predictors in breeding and management programs (Jahan *et al*., 2013; Shirzeyli *et al*., 2013). These traits also help characterize breeds and select animals with desirable conformation linked to better growth, carcass quality, and economic returns (Kumar *et al*., 2017).

Because morphometric traits are affected by age, sex, breed, nutrition, and environment, they further reveal information about adaptability and developmental progress (Lakew *et al*., 2017). Measurements are typically taken early in the morning before feeding to reduce variation due to gut fill and ensure greater consistency (Mohammad *et al*., 2012). In Nigeria, several

investigations have validated the effectiveness of these traits for weight prediction and breed characterization in local sheep populations (Sowande and Sobola, 2008; Sam *et al*., 2023).

2.2 Key Morphometric Traits

Heart Girth: Heart girth (chest circumference taken just behind the forelegs) is widely regarded as the single best predictor of body weight in sheep. It reflects thoracic development, muscle mass, and overall body condition (Lakew *et al*., 2017). Numerous studies across different breeds and environments have demonstrated a robust positive correlation between heart girth and live weight (Kumar *et al*., 2017; Shirzeyli *et al*., 2013). In Nigerian indigenous sheep, particularly West African Dwarf breeds, heart girth has repeatedly emerged as a highly significant predictor (Sowande and Sobola, 2008; Sam *et al*., 2023). Its ease of measurement and strong predictive power make it especially valuable for on-farm use.

Body Length: Body length, typically measured from the shoulder to the base of the tail, indicates longitudinal skeletal growth. It shows consistent positive relationships with body weight in various sheep populations (Kumar *et al*., 2017; Shirzeyli *et al*., 2013). Animals with greater body length tend to have larger frames that support more muscle and higher carcass yields. In Nigerian studies, body length frequently combines effectively with heart girth to improve prediction accuracy (Sam *et al*., 2023).

Withers Height: Withers height measures the vertical distance from the ground to the highest point of the shoulders and serves as an indicator of frame size and stature (Mohammad *et al*., 2012). While not always the strongest single predictor, it contributes meaningfully to multiple regression models and enhances overall estimation accuracy (Agamy *et al*., 2015; Kumar *et al*., 2017). Significant associations between withers height and body weight have also been documented in Nigerian indigenous sheep (Sam *et al*., 2023).

Sternum Height and Rump Height: Sternum height and rump height provide additional information on body conformation and skeletal proportions (Tyasi *et al*., 2020). Although used less frequently than heart girth or body length, these measurements show meaningful correlations with live weight and can improve model performance when included (Sun *et al*., 2020; Tyasi *et al*., 2020). They are particularly helpful for capturing structural variation in diverse indigenous populations.

2.3 Approaches to Body Weight Prediction

Regression analysis remains the most common and practical method for developing body weight prediction equations (Mohammad *et al*., 2012). Simple linear models using one trait (usually heart girth) are easy to apply but often limited in accuracy. Multiple regression models that combine several morphometric traits generally deliver superior results (Agamy *et al*., 2015; Sam *et al*., 2023). Studies on West African Dwarf sheep have shown that combinations of heart girth, body length, and withers height can explain a large proportion of variation in body weight. Allometric and polynomial models have also proven effective in some Nigerian breeds

(Afolayan *et al*., 2006; Sowande and Sobola, 2008). Sam *et al*. (2024) have extended similar morphometric and prediction approaches to poultry. For instance, they developed models for predicting body weight of Nigerian indigenous turkeys using morphometric traits at 18 weeks of age.

3.0 Conclusion

Accurate body weight estimation is fundamental to efficient sheep production and management. Morphometric traits offer a reliable, inexpensive alternative to direct weighing, especially for smallholder farmers in resource limited settings. Heart girth consistently stands out as the most dependable single measurement, while combinations of heart girth, body length, and withers height yield the highest prediction accuracy. Adopting these morphometric based approaches can significantly support breeding, feeding, animal healthcare, and marketing decisions. Continued research should focus on developing breed and environment specific equations using advanced statistical methods to further enhance precision and practical application.

References

Abbas, A., Ullah, M. A., and Waheed, A. (2021). Body weight prediction using different data mining algorithms in Thalli sheep: A comparative study. Veterinary World, 14(9), 2332–2338. https://doi.org/10.14202/vetworld.2021.2332-2338

Afolayan, R. A., Adeyinka, I. A., and Lakpini, C. A. M. (2006). The estimation of live weight from body measurements in Yankasa sheep. Czech Journal of Animal Science, 51(8), 343–348.

Agamy, R., Abdel-Moneim, A. Y., Abd-Alla, M. S., Abdel-Mageed, I. I., and Ashmawi, G. M. (2015). Using linear body measurements to predict body weight and carcass characteristics of three Egyptian fat-tailed sheep breeds. Asian Journal of Animal and Veterinary Advances, 10(7), 335–344. https://doi.org/10.3923/ajava.2015.335.344

Akpa, G. N., Suleiman, I. O., and Alphonsus, C. (2011). Effect of age, hair type and body condition score on body conformation traits in Yankasa rams. Nigerian Journal of Animal Science, 13, 32–37.

Alphonsus, C., Sam, I. M., Opoola, E., & Ayigun, A. E. (2012). Correlated relationship amongst performance and carcass characteristics in broiler chicken raised to maturity. Animal Production Research Advances, 8(1), 50–53.

Asefa, B., Teshome, A., and Abera, M. (2017). Prediction of live body weight from heart girth measurement for small ruminants in Ethiopia: A review. International Journal of Agricultural Research, Sustainability and Food Sufficiency, 4(4), 193–201.

Babale, D. M., Abaya, U. H., and Gworgwor, Z. (2018). Relationship between liveweights, linear body measurements and cost prices of small ruminants sold in and around Mubi environs, Adamawa State, Nigeria. Journal of Dairy, Veterinary and Animal Research, 7(6), 273–277. https://doi.org/10.15406/jdvar.2018.07.00226

Birteeb, P. T., and Lomo, R. (2015). Phenotypic characterization and weight estimation from linear body traits of West African Dwarf goats reared in the transitional zone of Ghana. Livestock Research for Rural Development, 27(9), Article 175.

Birteeb, P. T., and Ozoje, M. O. (2012). Prediction of live body weight from linear body measurements of West African long-legged and West African Dwarf sheep in northern Ghana. Online Journal of Animal and Feed Research, 2(5), 427–434.

Chitra, R., Rajendran, S., Prasanna, D., and Kirubakaran, A. (2012). Prediction of body weight using appropriate regression model in adult female Malabari goat. Veterinary World, 5(7), 409–411.

Jahan, M., Tariq, M. M., Kakar, M. A., Eyduran, E., and Waheed, A. (2013). Predicting body weight from body and testicular characteristics of Balochi male sheep in Pakistan. Journal of Animal and Plant Sciences, 23(1), 14–19.

James, I. J., Osinowo, O. A., and Amoo, T. O. (2007). Estimation of liveweight from chest girth and wither height measurements in West African Dwarf goats. Nigerian Journal of Animal Production, 34(2), 187–192. https://doi.org/10.51791/njap.v34i2.1178

Kumar, S., Dahiya, S. P., Malik, Z. S., and Patil, C. S. (2017). Prediction of body weight from linear body measurements in sheep. Indian Journal of Animal Research, 52(9), 1263–1266. https://doi.org/10.18805/ijar.B-3360

Kumari, R., Kumar, R., Meena, A. S., Jyotsana, B., Prince, L. L. L., and Kumar, S. (2014). Genetic polymorphism of growth hormone gene in native sheep breeds of India. The Indian Journal of Small Ruminants, 20(2), 15–18.

Lakew, M., Tesema, Z., and Zegeye, A. (2017). Body weight prediction from linear body measurements in Awassi crossbred sheep of North Eastern Ethiopia. Journal of Applied Agriculture and Biotechnology, 2(2), 28–36.

Mohammad, M. T., Rafeeq, M., Bajwa, M. A., Awan, M. A., Abbas, F., Waheed, A., Bukhari, F. A., and Akhtar, P. (2012). Prediction of body weight from body measurements using regression tree (RT) method for indigenous sheep breeds in Balochistan, Pakistan. Journal of Animal and Plant Sciences, 22(1), 20–24.

Musa, A. M., Idam, N. Z., and Elamin, K. M. (2012). Regression analysis of linear body measurements on live weight in Sudanese Shugor sheep. Online Journal of Animal and Feed Research, 2(1), 27–29.

Okon, L. S., Sam, I. M., Usoro, O. O., & Udo, A. F. (2023). The relationship between the coat colours with morphometric traits of West African dwarf goat raised in Akwa Ibom State, Nigeria. Animal Research International, 20(3).

Sam, I. M., and Udo, A. F. (2025). Evaluation of body weight and morphometric traits of two strains of layer chicken at grower phase of production. In Proceedings of the 50th Annual Conference of the Nigerian Society for Animal Production (NSAP), Federal University of Lafia, Lafia, Nigeria, 16 – 2016-20 March. Pp. 141-144

Sam, I. M., Essien, C. A., & Ekpo, J. S. (2020). Phenotypic correlation and carcass traits prediction using live body weight in four genetic groups of rabbit raised in tropical rain-forest zone of Nigeria. Nigerian Journal of Animal Science, 22(2), 48–56. https://njas.org.ng/index.php/php/article/view/948

Sam, I. M., Essien, C. A., Usoro, O. O., and Evans, E. I. (2024). Prediction of body weight of Nigerian indigenous turkey using morphometric trait measurements at eighteen weeks of age. Nigerian Journal of Animal Production, 37–40. https://doi.org/10.51791/njap.vi.4163

Sam, I. M., Udo, A. F., and Oloruntobi, E. A. (2026). Predictive modelling for broiler body weight: Integrating sexual dimorphic variance and correlation heat mapping. Journal of Animal Science and Veterinary Medicine. Advance online publication. https://doi.org/10.31248/JASVM2026.662

Sam, I. M., Udo, A. F., Ekpo, J., and Okon, L. S. (2025). Linear and multiple regression models for predicting body weight, egg and yolk weights of Isa Brown and Nera Black chicken strains raised in the humid tropics. Journal of Animal Science and Veterinary Medicine, 10(5), 447–453. https://doi.org/10.31248/JASVM2025.606.

Sam, I. M., Usoro, O. O., and Udo, A. F. (2023). Relationship of linear body measurements with live body weight in West African Dwarf sheep raised in Tropical Rainforest of Nigeria. Journal of Animal Science and Veterinary Medicine, 8(2), 46–51. https://doi.org/10.31248/JASVM2023.365

Sandeep, K., Dahiya, S. P., Malik, Z. S., and Patil, C. S. (2017). Prediction of body weight from linear body measurements in sheep. Indian Journal of Animal Research, 52(9), 1263–1266. https://doi.org/10.18805/ijar.B-3360

Shirzeyli, F. H., Lavvaf, A., and Asadi, A. (2013). Estimation of body weight from body measurements in four breeds of Iranian sheep. Songklanakarin Journal of Science and Technology, 35(5), 507–511.

Sowande, O. S., and Sobola, O. S. (2008). Body measurements of West African Dwarf sheep as parameters for estimation of live weight. Tropical Animal Health and Production, 40(6), 433–439. https://doi.org/10.1007/s11250-007-9119-9

Sun, M. A., Hossain, M. A., Islam, T., Rahman, M. M., Hossain, M. M., and Hashem, M. A. (2020). Different body measurement and body weight prediction of Jamuna basin sheep in Bangladesh. SAARC Journal of Agriculture, 18(1), 183–196. https://doi.org/10.3329/sja.v18i1.48392

Tyasi, T. L., Mathye, N. D., Danguru, L. W., Rashijane, L. T., Mokoena, K., Makgowo, K. M., ... and Maluleke, D. (2020). Correlation and path analysis of body weight and biometric traits of Nguni cattle breed. Journal of Advanced Veterinary and Animal Research, 7(1), 148–155. https://doi.org/10.5455/javar.2020.g404

Udo, A. F., Sam, I. M., and Udo, M. D. (2025). Evaluation and correlation of egg quality traits between Isa Brown and Nera Black commercial layer strains. Animal Research International, 22(3), 6472–6482.