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Chest Girth Measurement is an Alternative Method to Measure Body Weight in Goats of PNGUNRE Farm

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Abstract:- A total of N=19 (n=6 males: n=13 females) goats of various age groups (3 months -3years) were weighed using the two methods; body weights were weighed using a galvanized clock face weighing scale and girth circumference were measured using girth tape measure. The goats are of tropical breeds introduced to PNGUNRE in 2009 from Lae, Morobe province and have adopted well to the environment in East New Britain province. Since introduction, goats have inbred over the years with less knowledge of body weight differences being affected by inbred lines. The current study was developed to identify an alternative method to weigh goats despite other factors affecting goat breeding, nutrition and health status of goat production. Body weight estimates is a profitable parameter to be measured to allow manageable market decisions, selection, breeding, nutrition and assess health status. The measured parameters; BW and GC were analyzed using SPSS version 16.0. One-way ANOVA was used for statistical analysis and mean comparison, partial correlation analysis was done for correlations between BW and GC. The results of the current study show corresponding mean values of 29.484±9.1335 kg and 27.668±2.9618 cm for body weights using weighing scale and girth circumference using tape measure respectively. The similarity in mean values are highly correlated ($p = 0.00 < \alpha = 0.05$) at 95% confidence level. Girth circumference measurement is an alternative method to weigh goats whilst it is the cheapest method for the farmers to attain for practical husbandry practices.

Keywords:- *Goats, Body Weights, Girth Circumference, Correlation.*

I. INTRODUCTION

This research was carried out at the PNGUNRE Farm using (N=19 goats) from August to October, 2019 specifically to investigate the body weight correlation of goats' girth body measurement. There is a significant result $p=0.00<\alpha=0.05$ at 95% confidence level. The mean body weights and girth measurements are relatively similar. This indicates that body weight can be measured using girth circumference method to estimate the growth performance of goats.

Botha and Bath, (2018), observed that there is a strong correlation (up to 0.95) between live body weight and girth circumference have been demonstrated in various species like horses, cattle, pigs, sheep and goats. They further disputed stating that correlations of the two measurements are often not correct for indigenous or exotic breeds, therefore it is appropriate to measure across breeds of various ecological zones.

Goats are multifunctional farm animals and play a significant role on the economy and nutrition of landless, small scale and marginal farmers. Goat rearing is practiced by a large section of people living in rural and semi- urban areas. Goats can survive with or without industrial by products and be profitably reared on less nutritious forages such as shrubs and trees in a land where most minerals and plant nutrients have been depleted due to continuous cropping. Nutritional factors have significant influences on the growth performance, structural and biochemical characteristics of carcass and on meat quality traits (Yang *et al*., 2012). They contribute to livestock industry providing employment, sustains nutrition and buffers food security to produce meat, milk, wool, skin (Botha and Bath, 2018) and manure for landless and marginal farmers participating in small scale farming systems. Income earned from livestock production is a major contributor to the livelihoods of rural people and forms a conversion of capital investment into cash.

In order to increase the meat yield in goats, genetic improvement, breeding and selection would be required. Environmental influences and considerations to improve housing and health conditions also contribute to improve production traits like body weight. Live body weights provide essential directions for correct husbandry practices in rural areas such as to treat diseased goats most often caused by internal helminth parasites. Botha and Bath, (2018) reported the important areas of estimating live body weights in goats. These include administration of correct dose of medication to treat internal helminth parasites, farmers could avoid the likelihood of under or over-dosing of veterinary compounds and to assist breeding programs, feeding and health conditions.

However, this fundamental knowledge of body weight is often unavailable to those working with goats in the small-scale farming sector, due to the unavailability of scales. It becomes a disadvantage for the small-scale farmers to afford the weighing scale. The most spontaneous way to assess body mass is weighing animals with a spring balance, a steelyard balance or any suitable scale. However, such devices are too expensive for most small-scale farmers.

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Using spring or steelyard balances can be painful because animals need to be lifted up. The spring in the scale can permanently stretch with repeated or out-of-bounds use, resulting in biased measurements. Scale calibration and maintenance require skilled technicians. Therefore, the conditions for accurate weighing are seldom met in the field.

II. MATERIALS AND METHODS

2.1 Number of goats

A total of 20 goats (3 months to 3 years old) were tagged; tag 18 died while only 19 goats of varying age and size were used towards the end of study period. Ahmed *et al*., (2017) measured live body weights using Seventy -eight Sudanese local breed goats of ages 4-8 months of age weighing 4-15kg to predict the body weights and heart girth.

The goats are raised under free range farming practices with night housing provided. Khan *et al., (*2006) reported that when compared to other domestic animals, goats are the victims to prejudice and neglected because less attention is paid to their housing and feeding by their owners. Goats at PNGUNRE farm are allowed to graze in the pasture fields from 7:00 am to 3:00 pm on fine weather conditions. Normal feeding hours are often affected by unpredicted weather patterns in the tropics. Forage supplements (zea maize leaves or glaricidia leaves etc.) are fed during prolong bad weather conditions. Goats are introduced to pasture fields to browse pasture and other forages to meet their nutritional requirements each day.

2.2 Goat Identification

Individual goats with their tag numbers were weighed every week to record the body weights into a record sheet against their ID numbers. Their tag numbers were created using commercial tags (ALFLEX, Laza tags) bought from New Zealand. The tags came in pairs as male and female pieces which were punched together using a standard commercial ear tag applicator. Each goat was given an ID number from goat tagged 1 to goat tagged 20. Each tag was clearly printed with a commercial ear tag marker on each side of a tag pair to make sure each animal has the right tag to measure their body weight and girth circumference consecutively for three months.

2.3 Body weight (BW) and Girth Circumference (GC) Measurements

Weekly body weights and girth circumference (GC) or heart girth were measured using separate instruments. Hearth girth is a measurement of the circumference of the chest just behind the fore limbs (Gul *et al*., 2005). Body weight of goats were measured using a 5kg galvanized scale. A goat with a respective tag number was randomly selected and placed in a weighing bag (modified clinic bag) and hung to a hanging scale to take the reading. A hanging bag with a goat was free from coming in contact with any object before the reading was recorded directly from the hanging scale.

Girth circumference was measured on the same goat immediately after weighing. Girth circumference was measured using a sewing tape measure. It was measured by placing the tape across the chest, directly behind the fore legs with the goats standing squarely on all four legs (Slippers *et.al.*, 2000). The tape was placed with zero as the reference point to the observed reading taken for girth circumference. Girth circumference reading was recorded next to the body weight reading for correlation analysis.

2.4 Data Analysis

Body weight and girth circumference data were analyzed using SPSS version 16.0 for correlation. One sample t- test was performed to test the significance level for BW and CG parameters. Mean comparison was performed using one way-ANOVA to plot the graphs. (Table 1. Partial Correlation).

III. RESULTS AND DISCUSSIONS

Body measurements have been widely used for estimating animals' live weight especially when weighing equipment are not readily available (Ahmed *et al*., 2017). The prediction of body weight and its relationships to other morphometrical measurements produces applicable knowledge for breeding investigation with regard to meat production per animal (Allah *et al*., 2019). Investigations conducted by researchers leads to investigate the relationship of body weight with linear body measurements in goats in various global ecological zones. The relationship between heart girth and body weight has been studied in countries such as Botswana, Nigeria, Pakistan and South Africa, Eritrean goats (Badi *et al*., 2002), Kwazulu-Natal goats (Villers *et al*., 2009), Nguni goats (Slippers *et al*., 2000) and predicting live body weights (Gul *et al*., 2005). These studies have shown that the heart girth is the best parameter for estimating the body weight and that the height at wither can be used as a supplementary variable that can provide additional information. Villiers *et al*., (2009) estimated body weight using 1202 goats of various breeds, ages and sexes (55 bucks, 1053 does and 94 castrates), Botha and Bath, (2018) used 287 indigenous goats of different ages, sexes and pregnancy status. The studies concluded that the measurement of heart girth can be used to predict body weight of goats.

Hence, farmers have to rely on questionable estimates of the body weight of their goats, leading to inaccuracies in decision-making and poor husbandry practices. Such difficulties can be overcome by developing a simple, yet reasonably accurate method to predict the body weight. For instance, a prediction equation can be established, based on a linear body measurement (Villers *et al*., 2000). However, such measurements do not apply across breeds and climatic zones and thus specific models that give the best fit should be developed (Slippers, 2000). The most often used body weight prediction models do not adequately give the causal effects among morphological and body weight traits and other methods such as path analysis have been found to be more appropriate. For these reasons, this study was conducted to determine if chest girth measurements can be used effectively in the prediction of live body weights of goats.

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3.1 Body weight and Girth Circumference

Body weight of goats weighed using the scale is 29.484±9.1335 kg compared to girth circumference weighing 27.668±2.9618 cm for a total number of N=19 goats measured. The observed results of these measurements do not deviate with high differences. Standard deviation of BW from scale measurements ±9.1335 shows greater variations between the goat populations. On the other hand, standard deviation of GC ±2.9618 show less variations in CG. High differences in standard deviation could be due to varying age range. However, the mean of BW and GC shows no significant differences between the two different methods used.

Table 1. Descriptive statistics of BW and GC

Descriptive Statistics

	Mean	Std. Deviation	N
BW	29.484	9.1335	19
CG	27.668	2.9618	19
ID	10.105	5.8013	19

It is evident that the mean distribution graphs (Figure 1 and Figure 2) are comparably similar. The graphs (Fig 1 & 2) are reflective of BW and GC measured for individual goats. The plotted points are the measurements of BW and GC having the same measurement values in kg and cm. These are observed in tag (ID) 1 (30kg and 30 cm), ID 6 (24 kg and 24 cm) and ID 11(24 kg and 24 cm). Others also have approximately similar correlated trends for BW and GC. Fluctuations in body weight and girth circumference is directly influenced by age and sex distribution within the observed population N=19. The older goats are observed to have performed higher than the younger goats.

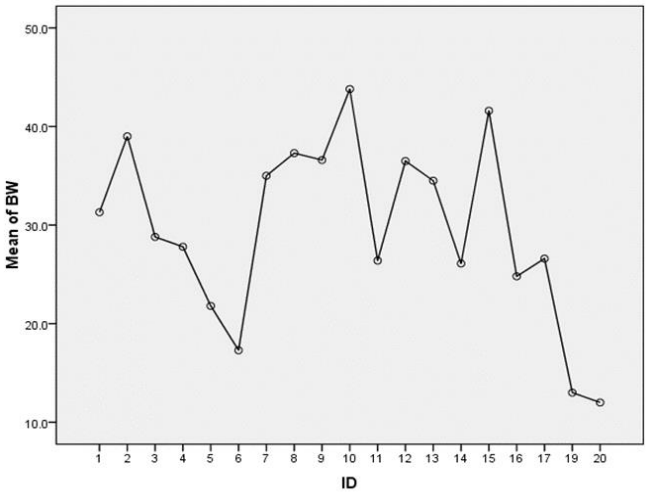

Figure 1. Mean of Body weight (kg)

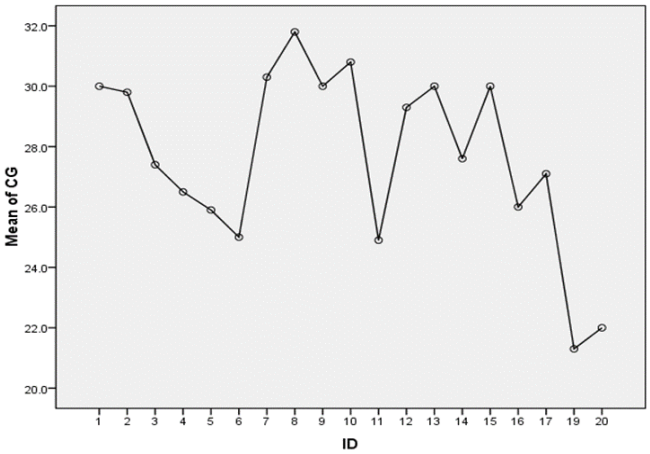

Figure 2. Mean of Girth circumference (cm)

Mean comparisons of BW and CG are observed to be highly correlated as it is indicated in Table 2 when correlation analysis was performed for two tailed significance tests. The significance value of *p*=0.000 shows similarity in BW and GC measurements. The t-test (Table 3) confirms high significance p=0.000 for BW and GC at 95 % confidence level. High significance of p-value =0.00 < 0.05 shows that the measurements using the two different methods (weighing scale and sewing tape measure) would give an approximate result of body weights using either of the instruments. However, GC measurement is an appropriate method as it is cheaper for the farmer to adopt the weighing technique. Girth measurement is also the cheapest technique for any goat farmer to estimate the body weight of goats at various growth stages. Slippers et al., (2000) observed that predicting the body weight of Nguni goats from a measurement of their heart girth is easy and accurate.

Table 2. Body weight and Girth circumference

Correlations

Control Variables			BW	CG
ID	BW	Correlation	1.000	.928
		Significance (2-tailed)	.	.000
		df	0	16
	CG	Correlation	.928	1.000
		Significance (2-tailed)	.000	.
		df	16	0

Table 3. One –Sample t-test for BW and GC

One-Sample Test

	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
ID	7.593	18	.000	10.105	7.31	12.90
BW	14.071	18	.000	29.4842	25.082	33.886
CG	40.720	18	.000	27.6684	26.241	29.096

IV. CONCLUSION

Body weight measurement using weighing scale is highly correlated ($p = 0.00 < \alpha=0.05$) to girth circumference measured using a girth tape measure. This positive correlation indicates that girth circumference measurement is a suitable method to weigh goats. It would be appropriate for a goat farmer to weigh goats using a tape measure to estimate the body weights than weighing the goats using a weighing scale because tape measure method is more convenient and cheaper for the farmer.

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