UNIVERSITI PUTRA MALAYSIA

EVALUATION OF GROWTH PATTERNS AND MATERNAL TRAITS OF BRAKMAS AND BALI COWS

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EVALUATION OF GROWTH PATTERNS AND MATERNAL TRAITS OF BRAKMAS AND BALI COWS

By

MOHD. HAFIZ BIN ABD WAHAB

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master Science

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بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ

This study is dedicated to my lovely wife, Nur Aisyah binti Mohamad Nazri and my precious children, Athilah Hayani and Alya Hanis, who always love, support and encourage me all the time. A special feeling of gratitude also goes to my beloved family, Abd. Wahab bin Yusof, Rodzmah binti Ab. Rahman and Afandi bin Abd. Wahab, who always pray for me and offer unconditional love and support. Thank you for being such wonderful persons in my life. May Allah grant all of us Jannah. Ameen.

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master Science

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September 2015

Chairman: Associate Professor Ismail Bin Idris, PhD
Faculty: Agriculture

Evaluation of animals performance including growth and reproduction are very important to the animal breeders as it will be the turning point of gaining profit or loss in livestock enterprises. To ensure the sustainability of a livestock operation, the animals must be evaluated and selected properly. However, the evaluation process especially on animals' growth often took a longer period; therefore the use of non-linear algebraic models is the best way to evaluate the growth event of the animals as it summarized the entire life data point into several biologically interpretable parameters. The objectives of the study were to determine the best non-linear model to describe the growth pattern of Brakmas and Bali cows and to compare the maternal traits of these two breeds. Four non-linear growth models namely Gompertz, von Bertalanffy, Brody and Logistic were used to determine the asymptotic size (A) and rate of maturing (k) for body weight, body length and hip height of Brakmas and Bali cows, while calving rate, pre-weaning viability and calf-crop weaned percentage were measured to evaluate the maternal traits. The goodness of fit of the models was determined by the highest coefficient of determination (R^2) and the lowest residual mean square (MSE). Logistic model was the best model to determine the mature weight (R^2=0.973; MSE=1037.4) and body length (R^2=0.993; MSE=81.2) for Brakmas cattle, while von Bertalanffy and Gompertz models were found to be the best models to describe the growth pattern for hip height for this cattle breed as these models had the same coefficient of determination and residual means squares value of 0.997 and 38.3, respectively. The von Bertalanffy model was found to be the best model to describe the growth pattern for body weight, body length and hip height for Bali cattle with the R2 of 0.973, 0.994 and 0.998, respectively, and the MSE of 601.9, 57.7 and 23.7, respectively. Although other competing models also showed a similar value of coefficient of determination,

the lowest residual mean square value became the determinant factor. It was also found that every model estimated negative correlation between the mature size and maturing rate, indicating that animals with slower growth will attain its mature size later than fast growing animals. Brakmas cattle showed higher maternal ability compared to Bali cattle in this study. It showed the superiority in calving rate ($p=0.0002$), pre-weaning survival ($p<0.0001$) and percentage of calf-crop weaned ($p=0.0079$). It is also revealed that apart from breed, age of dam become an important source of variation to determine the maternal abilities.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

CORAK PERTUMBUHAN DAN PENILAIAN INDUK BETINA LEMBU BRAKMAS DAN BALI

Oleh

MOHD. HAFIZ BIN ABD. WAHAB

September 2015

Pengerusi: Profesor Madya Ismail Bin Idris, PhD
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Penilaian prestasi haiwan termasuk pertumbuhan dan pembiakan adalah sangat penting untuk penternak haiwan kerana ia akan menjadi titik perubahan dalam memperoleh keuntungan atau kerugian kepada penternak. Untuk memastikan kemampanan operasi ladang ternakan, ternakan mesti dinilai dan dipilih dengan betul. Walau bagaimanapun, proses penilaian terutamanya aspek pertumbuhan sering mengambil masa yang lama, maka penggunaan model algebra tidak linear adalah cara terbaik untuk menilai prestasi ternakan kerana prestasi sepanjang hayat ternakan tersebut dapat diringkaskan kepada beberapa parameter yang boleh ditafsirkan secara biologi. Objektif kajian ini adalah untuk menentukan model tidak linear yang terbaik untuk menggambarkan corak pertumbuhan lembu Brakmas dan Bali serta untuk membandingkan ciri-ciri keibuan kedua-dua baka. Empat model pertumbuhan tidak linear iaitu Gompertz, von Bertalanffy, Brody dan Logistik telah digunakan untuk menentukan saiz asimptot (A) dan kadar matang (k) untuk berat badan, panjang badan dan ketinggian pinggul lembu Brakmas dan Bali, manakala kadar beranak , pra-susu daya maju, anak lembu tanaman bercerai susu peratus dan indeks produktiviti lembu diukur untuk menilai ciri-ciri ibu. Kebaikan penyuaian model ditentukan dengan pekali penentuan tertinggi (R^2) dan ralat kuasa dua min (MSE). Model Logistik adalah model yang terbaik untuk menentukan berat badan matang (R^2 = 0.973; MSE = 1.037.4) dan panjang badan (R^2 = 0.993; MSE = 81.2) untuk lembu Brakmas, manakala model von Bertalanffy dan Gompertz didapati model yang terbaik untuk menggambarkan corak pertumbuhan untuk ketinggian pinggul untuk baka lembu ini kerana model-model ini mempunyai nilai R^2 dan MSE yang sama iaitu 0.997 dan 38.3. Model von Bertalanffy didapati model terbaik untuk menggambarkan corak pertumbuhan untuk berat badan, panjang badan dan ketinggian pinggul untuk lembu Bali dengan R^2 masing-masing 0.973, 0.994 dan 0.998, dan MSE daripada 601.9, 57.7 dan 23.7. Walaupun model lain juga menunjukkan nilai R^2 yang sama, nilai MSE terendah menjadi faktor penentu. Hasil kajian juga mendapati bahawa setiap model menunjukkan korelasi negatif antara saiz matang dan kadar matang, yang menunjukkan bahawa haiwan dengan kadar matang yang lebih perlahan akan mencapai

saiz matang lewat daripada haiwan yang mempunyai kadar matang yang tinggi. Lembu Brakmas menunjukkan keupayaan ibu lebih yang lebih baik berbanding dengan lembu Bali dalam kajian ini. Ia menunjukkan kadar beranak ($p = 0.0002$), anak yang hidup sebelum sapih ($p < 0.0001$) dan peratusan anak sapih ($p = 0.0079$) yang lebih tinggi berbanding lembu Bali. Ia juga mendedahkan bahawa selain daripada baka, umur induk juga penting dalam menentukan sifat keibuan.

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Declaration by Members of Supervisory Committee

This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) are adhered to.

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LIST OF ABBREVIATIONS

° C	Degree Celcius
BK	Brahman-Kedah Kelantan
CCW	Calf-crop weaned
cm	Centimetre
df	Degree of freedom
DVS	Department of Veterinary Services
FK	Friesian-Kedah Kelantan
g / egg	Gram per egg
HK	Hereford-Kedah Kelantan
kg	Kilogram
KK	Kedah-Kelantan
km	Kilometre
MARDI	Malaysian Agricultural Research and Development Institute
MSE	Mean square error
RM	Ringgit Malaysia
SE	Standard error
vs	Versus

CHAPTER 1

INTRODUCTION

Livestock industry plays an important role in the agricultural sector in Malaysia. It contributes to a major source of animal protein for human consumption as well as employment opportunities (Loh, 2002). Production of poultry and swine subsectors has exceeded the rate of self-sufficiency, but not for the ruminant sector as the Malaysian Government targets self-sufficiency rate for large ruminant and small ruminant at 40% and 35% by 2015, respectively. In 2011, the self-sufficiency rate for large ruminant and small ruminant sub-sectors recorded at 29.02% and 11.28%, respectively, indicated that it is still far from the national target. The main problem in developing the ruminant industry in Malaysia is the lack of quality breeding stock in terms of productivity as the productivity is affected by genetic materials, environmental factors and the interaction of these factors (Lema *et al.,* 2011). Local Kedah-Kelantan cattle have a high fertility rate, but low in terms of growth and mature weight.

Crossbreeding is an effective tool to utilize the genetic resources optimally according to environment. It allows the combination of local and other genetic materials to produce better breed in terms of productivity economically (Lema *et al.,* 2011). As a result of crossbreeding and selection of Brahman and KK cattle, MARDI has successfully produced synthetic breeds of cattle, namely Brakmas which has a potential to be propagated under oil palm plantation. Bali cattle (*B. sondaicus, B. javanicus and Bos / Bibos banteng*) is one of the important beef cattle breeds in Indonesia (Purwantara *et al.,* 2012). Besides in Bali Island itself, Bali cattle are the mostly predominant in most of the eastern islands of Indonesia.

Breed characterization for productivity, maternal and calf performance are important as a basis to synchronize genetic resources with other production resources and need to be done comprehensively (Gregory *et al.,* 1985). Breed selection is essential to be used either in straight breeding or crossbreeding programs for herd improvement. Some criteria might be able to be evaluated at young age such as birth weight, weaning weight and average daily gain, but the evaluation of mature size, optimal body weight for production, maternal and reproductive traits will take a longer period to evaluate. The measurements of cattle's body dimension are widely used for genetic improvement of meat production performance in live beef cattle because it objectively could improve selection for growth by enabling the breeder to recognize early and late maturing animals of different sizes (Brown *et al.,* 1974), as the mature size impacts the profitability of beef enterprises (Marco *et al.,* 2010). Mature size of cows affect many aspects of production, including maintenance requirements (McMorris and Wilton, 1986; Montano-Bermudez *et al.,* 1990), reproduction (Buttran and Willham, 1989; Owens *et al.,* 1993; Olson, 1994) and culled cow value, and therefore the profitability of the cow calf operation (Rumph *et al.,* 2002). Information regarding the growth event in livestock is useful in developing a genetic improvement program to produce the most efficient biological type for a particular feeding environment in a specific market situation (Stobart *et al.,* 1986). Evaluation of growth by using long series of

body weight or body size changes observed throughout the life of animals are very difficult to explain (Kratochvilova *et al.,* 2002; Berry *et al.,* 2005), therefore fitting the entire life body measurements such as body weight, height and length to non-linear functions offers an opportunity to summarize the entire growth events into several parameters that can be interpreted biologically (Perotto *et al,* 1992; Berry *et al.,* 2005).

As a promising synthetic breed, Brakmas cattle have the potential to be propagated commercially in Malaysia especially under oil palm integration system. Bali cattle would be an option for the small farmers and commercial livestock enterprises, however the information about this breed in Malaysia are scarce. It is necessary to study and understand the growth pattern of Brakmas and Bali cattle as it is useful to develop genetic improvement program for these breeds. As mentioned above, growth is important aspect to look into as it will affect the reproduction efficiency including the maternal ability.

The objectives of this study were:

1. To determine the best non-linear model to estimate the growth curve parameters for Brakmas and Bali cattle

2. To evaluate the maternal traits of Brakmas and Bali cattle

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