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Bio-economic Model of Halal Goat Production System based on Experimentally Comparing Feeding with Madre de Cacao and/or with IPIL-IPIL (Maguindanao Province, Philippines)

Manan E. Undong [a*≡], Enrico P. Supangco [bφ], Rommel C. Sulabo [c#] and Rowena D. T. Baconguis [d#]

[a] Department of Agriculture, Maguindanao, Philippines.
[b] College of Agriculture, Animal and Dairy Science Cluster, University of the Philippines, Los Baños, College, Laguna, 4031, Philippines.
[c] Animal and Dairy Science Cluster, UPLB. Philippines.
[d] College of Public Affairs and Development, UPLB. Philippines.

Authors' contributions

This work was carried out in collaboration among all authors. Author MEU Main Author/Lead Researcher. EPS Dissertation Adviser. Author RCS Committee Member for the major subjects. Author RDTB Committee member for the cognate. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

The study was conducted to develop a bio-economic model of Halal goat production in Maguindanao, Philippines to serve as model to Muslim and non-Muslim goat raisers. Nineteen viable cooperatives in the province of Maguindanao were chosen as beneficiaries of the program. Model development, validation and use were done by adopting the STELLA version 4.0.1 computer software program. Interventions derived from the model were tested in the field. Experimental goats were stalled in pens, subjected under two treatments and a Control, and replicated in a

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≡ Agricultural Technologist;
φ Chair of Advisory Committee and Dean;
 # Member of Advisory Committee;
**Corresponding author: E-mail: manan_u@yahoo.com;*

completely randomized design. Descriptive statistics such as frequency and standard deviation were used. Analysis of variance (ANOVA) at 1% confidence level was also employed to determine the degree of significance of the observed differences among treatments. A total of eighteen (18) Halal goats with weight ranging from 10.0 – 11.0 kg were used in the field test. They were stall-fed for 90 days with the following treatments: Control (100% Guinea grass), Treatment 2 (50% Guinea grass + 50% Madre de cacao), and Treatment 3 (50% Guinea grass + 25% Ipil-ipil + 25% Madre de cacao). Water and granulated salt were also provided. Dry matter, total digestible nutrients and crude protein contents of Guinea grass, Madre de cacao and Ipil-ipil used in the feeding experiment were analyzed in the laboratory adopting the AOAC method. Growth was determined based on average daily gain in weight among experimental goats. Experimental animals subjected to Treatment 3 performed better than those in the Control and Treatment 2. Results reveal that a combination of Guinea grass, Ipil-ipil and Madre de cacao is still the most practical option in intensive goat feeding management. The study also proved that baseline model developed could be used as tool for Halal goat production system in the province of Maguindanao. Thus, modelling can be used to reduce number of treatments and built-in cost associated with the experimentation.

Keywords: Bio-economic model; stella; halal; stall-fed.

1. INTRODUCTION

The Halal goat production program in the province of Maguindanao is an offshoot of the national and regional agenda to jumpstart the Halal development industry in the country. The Department of Agriculture - Maguindanao initiated the program through goat dispersal in the selected municipalities.

Twenty-two (22) heads of breeder native goats were dispersed to qualified beneficiary-cooperatives and re-dispersal is progressing to the neighboring communities. Through this initiative, the ARMM region is anticipated to be the Halal hub of the country and one of the key players in the global Halal market in the future.

Goat raising remains a least prioritized agricultural enterprise in Maguindanao despite its agro-climatic edge and being a Muslim dominated province because of lower awareness about Halal goat production. The Halal-compliant goat production as a program of the government is a new concept among Muslim and non-Muslim communities. Consumer demand for Halal-compliant goats and its by-product is low, local marketing system is not standardized resulting to proliferation of price monopoly and intervention of intermediaries along the marketing channel. Most farmers prefer rice and corn farming to goat raising because of its immediate returns and less inputs. Farmers seldom plant quality forages. In fact, very few goat raisers grow improved grasses and legumes for their animal. Instead, they are dependent only on natural pastures and traditional management practices. Farmers also have limited information on the Halal-compliant and conventional way of raising goats. Therefore, it is eyed that continuous research in this endeavor is necessary to increase awareness of the Muslim and non-Muslim communities on Halal goat production as a viable enterprise.

2. MATERIALS AND METHODS

A conceptual model was formulated using the result of survey and a bio-economic model was developed and used to evaluate possible interventions. Three interventions were identified, namely: Treatment 2 (50% Guinea grass + 50% Madre de Cacao) and Treatment 3 (50% Guinea grass + 25% Ipil-Ipil + 25% Madre de Cacao). Data generated from the survey served as basis in modelling and simulation of Halal goat production system in Maguindanao province. Descriptive statistics (mean and standard deviation) were used in analyzing the interaction among different farming sub systems (animal, legumes and grass).Nutrient compositions of roughages used in the study were based on PHILSAN Feed Reference Manual 2010 edition and National Research Council. Likewise, nutrient requirements of goat at various growth stages were also considered.

Field test was conducted in one of the Halal goat farms located centrally to other farms. Analysis of Variance (ANOVA) in a Completely Randomized Design (CRD) was used for the study. Each treatment was replicated six times with one (1) animal per replication. Growing goats taken from the farmers' farm were fed for 90 days.

3. RESULTS AND DISCUSSION

In the field experiment, interventions with highly significant statistical t-test in the model validation were tested in the farmers' goat farm. A complete randomized design (CRD) with three (3) treatments and six (6) replications was used. A control and two treatments were applied to 10 kg goats. These are: Control (100% Guinea grass), Treatment 2 (50% Guinea grass + 50% Madre de Cacao) and Treatment 3 (50% Guinea grass + 25% Ipil-Ipil + 25% Madre de Cacao). Initial weight, body weight gain and final weight were recorded on a weekly basis. Six (6) upgraded native goats were assigned per treatment.

Nutrient contents of Guinea grass, Ipil-Ipil and Madre de Cacao fed to the goats were also subjected to proximate analysis. On the average, Madre de cacao plus Guinea grass contained 24.1% DM, 5.5% CP, and 38.14% TDN and the combine nutrient composition of Guinea grass, Ipil-ipil and Madre de Cacao are 25.1% DM, 19.8% CP and 40.24 TDN. Water is given adlibitum while salt is provided at the rate of 1 gm per head per day. Mean weight of animals in the field experiment were compared to the mean weight of the predicted treatments. Treatment 1 (50% Guinea grass + 50% Ipil-Ipil) was excluded because it is not statistically significant during model validation.

Six (6) upgraded native goats were confined for 90 days and fed with Guinea grass at a pre-determined rate of 1.40 kg per head per day on a fresh basis. Guinea grass that served as their basal diet contained 20.1% DM, 11.2% TDN and 2.0% CP (AOAC). The grass was offered to the goats twice a day (9:00 am and 3:00 pm). The goats were weighed every weekend to determine their weight increment and average daily gain.

Table 1 shows that goats in the control treatment recorded a final weight of 16.32 kilogram after 12 weeks, while those animals assigned in treatment 2 reached a final weight of 17.88 kilograms. Goats in the treatment 3 recorded a final weight of 18.07 kilograms after 90 days of feeding. From this result, it is observed that treatment 3 with a combination of Guinea grass, Ipil-Ipil and Madre de Cacao is a better feeding option. Guinea grass is low in crude protein but it is highly digestible and good feedstuff for ruminant animals [1]. The slow growth of the goats could be due to feeding adaptations and environmental adjustments because these animals were used to grazed in mixed natural grasses one of which is Guinea grass. This is the abundant grass species near the Halal goat farms in Parang, Maguindanao. Madre de cacao can improve intake and forage acceptance of goat [2]. They are usually planted along hedgerows as soil binder and perimeter posts. Ipil-Ipil is also abundant in the premises of goat farm. However, its utilization as fresh feedstuff is restricted due to its mimosine content.

The effect of different feed combinations in the goat's weight gain was also considered. Variables such as sex, breed, environment and temperature were not included in the observation. The average weight of the goats in the model prediction and field test were compared. Result shows that mean weight of goats in treatment 2 and 3 in the model prediction is higher than the control (Table 2).

Table 1. Weekly weight of goats in the three (3) treatments for 90 days.

Week	Weekly Weight (kg)		
	Control	Treatment 2	Treatment 3
0	10.00	10.00	10.00
1	10.75	10.85	11.02
2	11.32	11.75	11.87
3	11.82	12.40	12.72
4	12.38	13.07	13.62
5	12.88	13.75	14.48
6	13.48	14.45	15.35
7	14.05	15.15	16.20
8	14.55	15.83	17.05
9	15.12	16.50	17.95
10	15.62	17.18	18.82
11	16.22	17.88	19.68
12	16.32	17.88	18.07

Table 2. Comparison of mean weights of goats predicted by the computer model vs. mean weights of goats obtained from field test or experiment

	Mean Weight (kg)	
	Computer Predicted Data	**Field Test/Experiment Data**
TC	16.41[c]	16.32[b]
T2	18.34[b]	18.07[a]
T3	20.04[a]	18.07[a]
	$P < 0.0001$	$P = 0.0046$

Legend:

Tc	-	Guinea grass (Control)
T2	-	Guinea grass + madre de cacao
T3	-	Guinea grass + ipil-ipil + madre de cacao

**Figures with the same superscripts are not significantly different*

This difference is due to the supplementation of Ipil-ipil and Madre de cacao in the grass diet. The two legumes contains high amount of Total Digestible Nutrients (TDN) and Crude Protein (CP) compared to Guinea grass. However, between treatment 2 and 3, the later is significantly higher than treatment 2 in the model prediction because Guinea grass has very low nutrient contents when feed solely to the goat.

On the other hand, the average weight of goats in treatment 2 and 3 in the field test are the same. They are significantly higher than the control treatment. These differences can be due to supplementation of legumes in the grass diet. Moreover, analysis of variance among treatments revealed that Treatment 3 was highly significant compared to TC and T2. A computed F-value of 248.143 reveals that treatments are significantly different at 1% level. This indicates that feeding Halal goat with a combination of Guinea grass + Ipil-ipil + Madre de Cacao is a better feeding option at farmers' field in Maguindanao province. This result coincides with the findings of Aregheore & Perera [2] and Hayashida et al. [3], which proved that addition of legumes in the grass diet improves weight gain of goat.

Improved grass alone cannot suffice the nutrient requirement of the growing goat because it is low in crude protein as one of the basic nutrients required by ruminant like goat. However, adding leguminous forage such as ipil-ipil and madre de cacao in the diet supplies the deficient protein requirement.

Moreover, ipil-ipil should only be included in the ruminant diet not more than 5% due to its anti nutritional factors. In feeding the madre de cacao and ipil-ipil, the younger leaves and stem should be offered to the goats, because they preferred the softer parts.

Furthermore, the combination of guinea grass as the basal diet plus the ipil-ipil and madre de cacao meet the nutrient requirement of growing goats in terms of Crude Protein, Total Digestible Nutrient, Calcium, and Phosphorus. These fodder mixture should be chopped before offering to the goat to facilitate chewing and regurgitation process.

Other leguminous crops such as flemingia can also be integrated in the basal diets though it is observed that growing goats preferred ipil-ipil and madre de cacao as supplement to the basal diets.

Though goats consumed forages estimatedly at 10% of its body weight on as fed basis, it should not be overfed to prevent occurrence of dietary disorders which may complicate to reproductive disorders.

4. CONCLUSIONS

Based on the findings of the study, bio-economic modelling (in this case, the use of STELLA Version 4.01) can be used to trim experimental treatments, reduce cost of conducting an experiment, facilitate hypotheses testing even if the environmental conditions do not favor field experimentation and improve management interventions for a particular process.

The differences in the proximate composition of grass and legumes used in model development and those used in the actual feeding of animals resulted to slight variation in the data which further indicate that the baseline model developed in this study can represent the actual management practices in Halal goat raising in the province of Maguindanao.

ETHICAL APPROVAL

Ethical approval was taken from ethical committee.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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