The Level of Dwarf Elephant Grass (*Pennisetum Purpureum* cv. mott) To Substitute Indigenous Forage for Goat Feed in Limestone Mountain

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Abstract. This research aimed to investigate on the level of supplementation of dwarf elephant grass that was introduced ex-limestone mining open area as to substitute indigenous forage for goat feed in limestone mountain. The method used in vivo experimental research was conducted in a completely randomized design. Sixteen local male goats in a limestone mountain weighed 24.8 kg ± 1.66 were allotted to four treatments with different level of dwarf elephant grass to substitute indigenous forage 0, 25, 50, and 75% each with four replicates. The measured parameters were feed intake and body weight gain. The research was conducted in a limestone mountain in Gombong, Central Java Indonesia. The result showed that substituting indigenous forage with dwarf elephant grass up to 75% produced non-significantly different (P>0.05) feed intake and body weight gain of goats. The research concluded that dwarf elephant grass can substitute indigenous forage for goat feed, however it is recommended to substitute indigenous forage with up to 25% dwarf elephant grass to obtain an optimal weight gain to goats in limestone mountain.

Keywords: dwarf elephant grass, indigenous forage, goat, limestone mountain

1. Introduction
Limestone mountain in Indonesia covers a 15.4 million hectare area that spreads out from the western tip of Sumatra to the eastern end of Papua. Karst mountain has a strategic function because limestone is versatile for construction material and concrete mixing ingredient. There has been an extensive karst mining to supply the demand for infrastructure around Indonesia. Negative impact of limestone mining is the changing ecosystem where an open area replaces what used to be a karst mining site. Consequently, the diversity and productivity of indigenous forage decline up to 50%, and soil fertility that used to contain 0.049 – 0.141% N total, 0.067 – 0.133% P<sub>2</sub>O<sub>5</sub> total, and 0.086 – 0.100% K<sub>2</sub>O total...
also decreases [1]. Many people living in the perimeter of limestone mountain breed goat as a side job to support their family. Therefore, the changing ecosystem may potentially reduce the productivity of goat breeding in the limestone mountain [1].

One of the efforts to address the changing ecosystem is by revegetating the open area – introducing dwarf elephant grass (Pennisetum purpureum cv Mott). Dwarf elephant grass is a popular grass in Indonesia and goats like it because the leaf is tender without trichomes, and it adapts well to marginal land. Dwarf elephant grass (Pennisetum purpureum cv Mott*) has many benefits such as a high productivity, 10-15% protein, low crude fibre, leaves and stem with soft and tender texture, and a high percentage of leaves (76%) [2] [3]. Dwarf elephant grass contains 13.55% dry matter, 14.45% ash, 13.94% crude protein and 71.43% digestibility [4].

Introduced dwarf elephant grass in a former limestone mining have successfully area in monoculture system or mixed with seasonal legume using 1.5kg/m² goat compost (15 ton/ha) as the primary fertilizer. Fresh forage yield was only 8.4 ton/ha; it was much less than dwarf elephant grass planted in common land that could reach 20 ton/ha. The introduction of dwarf elephant grass in the former limestone mining area should be followed up by an investigation on the level of supplementing dwarf elephant grass to substitute indigenous forage for goat feed in limestone mountain [5].

2. Methodology
An in vivo experimental research was conducted in a completely randomized design (CRD). The research materials included 16 male indigenous goats from the limestone mountain weighed 24.8 kg ± 1.66, indigenous forage, and dwarf elephant grass (Pennisetum purpureum cv Mott) introduced in the former limestone mining area. The nutrient content of dwarf elephant grass and indigenous forage is presented in Table 1. The location of the research was a limestone mountain in Gombong, Kebumen district, Central Java, Indonesia.

| Table 1. Nutrient content of the experimental forage |
|---------------------------------|---------------------------------|---------|---------|---------|---------|
| Forage                          | Water content                  | Ash     | Crude fat| Crude fibre| Crude protein |
|---------------------------------| %                               |         |          |           |            |
| Pennisetum purpureum cv Mott    | 81.31                           | 14.56   | 2.06     | 36.03     | 11.93     |
| Indigenous forage               | 77.54                           | 11.55   | 1.81     | 37.93     | 12.34     |

The treatments consisted of four levels of dwarf elephant grass supplement to substitute indigenous forage: R0 (100% indigenous forage), R1 (75% indigenous forage + 25% dwarf elephant grass), R2 (50% indigenous forage + 50% dwarf elephant grass) and R3 (25% indigenous forage + 75% dwarf elephant grass) with four replicates. The measured parameters were the biological response of goat that included feed intake and body weight gain. The obtained data were subject to analysis of variance, and any differences were followed by the Least Significant Difference Test [6].

3. Result and Discussion
Indigenous forage of limestone mountain
One of the limestone mountains in Indonesia is the 7000 hectare Gombong limestone mountain in Central Java, Indonesia that covers three subdistricts – Ayah, Rowokele and Buayan. Most people living in Gombong limestone mountain keep goats as a side job to help support their family. Goat breeding in the slope of Gombong limestone mountain is very dependent on productivity, quality and continuity of the indigenous forage that keeps dwindling due to the extensive limestone mining [7].
Reported that there are 33 indigenous plant species in Gombong limestone mountain for livestock such as *Ageratum conyzoides*, *Commelinadifusa*, *Eleusineindica*, *Eragrostisamabillis*, *Hyptiscapitata*, *Imperata cylindrica* and *Themeda arguens* [8]. Furthermore stated that indigenous forage for goat feed in the limestone mountain area is affected by vegetation density; a thick density includes 20 species while medium density has 36 species. A diverse indigenous forage suffers a significant decline due to karst mining activity, then reported there were only seven to 13 species of indigenous forage in the former limestone mining area [9].

Goat farmers in Gombong limestone mountain offer a varied diet for the goat that consists of six species of grass, four legumes, ten shrubs and two tree plants. The common indigenous forage for goat feed is *Cynodon dactylon*, *Eragrostis amabillis*, *Eulalia amaura*, *Hyptis capitata*, *Centrosuma pubescens*, *Calliandra calothyrsus*, *Ageratum conyzoides*, *Neptuna lutea* [10].

**Fresh forage intake**

Forage intake is affected by palatability which is attributed to the livestock habit, forage texture and nutrient content. Dwarf elephant grass is unpopular forage among goat farmers in Gombong limestone mountain, so the farmers never feed their goats with the grass. Therefore, it is crucial to give a seven-day adaptation before data collection started, so that the goats could consume dwarf elephant grass in a normal way. The present study showed that the forage intake was 97.5 – 98.8 kg or around 3.1 – 3.3 kg per day. The high daily forage intake was because the goats were 11-12 months male with a high growth rate. Also, the forage was offered regularly three times a day in the morning, midday and afternoon. A study on female Marica goats weighed 10-21kg reported that the goat consumed 1.3-1.8 kg mixed forage (natural grass and legume) per day [11]. It indicated that fresh forage intake was affected by goat body weight, species, sex and the type of forage.

The result of dwarf elephant grass as the substitute of indigenous forage for goat feed is presented in Figure 1. The analysis of variance in Figure 1 shows that substituting indigenous forage with dwarf elephant grass up to 75% did not significantly affect (P>0.05) forage intake. Supplementing dwarf elephant grass in goat feed decreased fresh forage intake.

![Figure 1](image_url)

**Figure 1.** Fresh forage intake in the research (28 days)

( ns : non significantly )

**Dry matter forage intake**

Dry matter intake of male indigenous goats in limestone mountains was 15.49 – 17.86 kg or 0.55 – 0.64 kg per day (2.3% body weight). A study byon 10-12-month-old male Merino weighed 40- 50 kg reported that dry matter intake of forage with legume hay reached 1.09 kg per day or 2.7% body weight.
weight. It showed that male indigenous goats in limestone mountain had a normal dry matter intake which consisted of dwarf elephant grass and indigenous forage [12].

This result showed that dry matter intake is affected by body weight, goat species and the type of forage. Moreover, supplementing dwarf elephant grass up to 75% to substitute indigenous forage tends to decrease dry matter intake. However, the result of analysis of variance indicated that supplementing dwarf elephant grass up to 75% did not significantly affect (P>0.05) dry matter intake (Figure 2).

![Figure 2. Dry matter intake of forage feed in the research (28 days)](ns: non significantly)

**Body weight gain**

The present study reported that the fresh forage intake was 97.5 – 98.8 kg or 3.4 – 3.5 kg per day (12% of body weight); however, body weight was reported 1.68 – 2.28 kg or 0.04 – 0.06 kg per day. This finding is similar to 0.048 – 0.058 kg of Ngitung et al. [13] on female Marica goats consuming native and superior grass. However, on female Kacang goat aged 9-12 months old reported 0.095 gram daily body weight gain. The goats for the present study were 11-12 months old, which, according to Sarwanto et al. [15] could not grow at a fast rate [14].

The result showed that the highest goat body weight gain during research (28 days) was in R1 treatment (25% dwarf elephant grass), followed by R2 (50% dwarf elephant grass), R0 (100% indigenous forage) and R3 (75% dwarf elephant grass) as presented in Figure 3.
Figure 3. Body weight gain during study (28 days)
( ns : non significantly )

The result of analysis of variance showed that supplementing 0%, 25%, 50% and 70% dwarf elephant grass did not significantly affect (P>0.05) body weight gain of indigenous goats. The result indicated that forage formulation which included dwarf elephant grass produced a relatively similar body weight gain with the feed that only consisted of indigenous forage from the limestone mountain.

However, Figure 3 shows that feed consisted of 25% dwarf elephant grass and 75% indigenous forage resulted in a relatively higher daily weight gain. Similarly, reported that supplementing 25% dwarf elephant grass to substitute indigenous forage produced a higher in vitro dry matter digestibility (63.06%), while 50% and 75% dwarf elephant grass resulted in 61.86% and 59.62%, respectively. In vitro organic matter digestibility of dwarf elephant grass supplement at 25%, 50% and 75% was 56.82%, 55.95% and 55.3%, respectively [15]. It shows that supplementing dwarf elephant grass more than 25% would decrease dry matter and organic matter digestibility.

4. Conclusion
Dwarf elephant grass (Pennisetum purpureum cv Mott) introduced in the former karst mining area could substitute indigenous forage karst mountain up to level 75%. However, from the tendency of goat’s biological response, supplementing dwarf elephant grass should be limited to 25%.

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