Replacement of Napier grass with legume tree foliage in the coconut-beef cattle integrated farming system (Coco-Beef IFS)

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Abstract

In order to increase understanding of the contribution of forage legumes to the development of sustainable cattle farming, we gathered data from an experiment *in situ* on the land under coconut plants, cultivated with the legume tree *Indigofera zollingeriana*. and the grass *Pennisetum purpureum* cv. dwarf situated in Blongko, South Minahasa Regency, Indonesia. The study aimed to determine the effect of substitution of *Pennisetum purpureum* forage by *Indigofera* sp on liveweight gain of beef cattle (Peranakan Sumba) (n=12) aged between 18 and 24 months. The treatments were ratios (fresh basis) between the grass *Pennisetum purpureum* and *Indigofera* legume of: 100:0, 60:40 and 40:60. Feeding was the equivalent of three percent of LW as DM, and was twice a day, while drinking water was given *ad libitum*. After a two-week adaptation period,data were collected for three months. There was a linear response (R^2 = 0.97) in live weight gain as *Indigofera* foliage replaced up to 60% of the grass.

Key words: *environment, Indigofera zollingeriana, stocking rate, sustainability*

Introduction

Legume forage production offers multiple environmental benefits and can enhance sustainability of farming, although legume competitiveness is frequently constrained by lower gross margins compared to agronomical cropping alternatives. However, it can be improved by appreciating the increase in yield of subsequent crop(s) and, potentially, to reduce input requirements as fertilizer, biocide and tillage (Preissel et al 2015). Attributes that contribute to environmental sustainability are reduction in greenhouse gas emissions as tree crops capture more carbon than crops or grasses (Osak and Hartono 2016). The use of fodder legumes brings about significant advantages in terms of overall environmental sustainability

(Papendiek et al 2016) especially mitigation of greenhouse gas effects (Preston and Leng 1989).

Quantity and quality of forage in the tropics, such as in South Minahasa regency, fluctuates especially during the dry season resulting in a decrease in the level of productivity of cattle with low levels of growth. Tree legume forage has been known to have potential as a source of high-quality feed, especially during the dry season when the availability of grass decreases sharply. In addition, tree legumes are less affected by adverse environmental conditions such as the dry season compared to grasses, so trees and shrubs can be an important source of feed during the season (Speedy and Pugliese 2011).

One type of tree legume plant that has been familiarized in the region is the legume *Indigofera* sp the foliage of which is rich in protein, calcium and phosphorus (ACIAR 2019; Zahran 1999).

Planting of legume trees in coconut fields and the use of compost based on livestock manure on coconut and forage crops can save fertilizer costs, by eliminating chemical fertilizers so as to increase forage and coconut products that are more productive. Integration of legume trees, grasses and cattle in coconut plantations is expected to increase land productivity (Anis et al. 2014).

The reasons why we must move away from grasses as the major feed for ruminants are that they produce more methane than tree legumes (Maselema and Chigwa 2017; Preston et al 2019) and they store less carbon than trees, so replacement of grasses with legume trees is alogical strategy to follow. The utilization of *Indigofera sp*. to replace grasses can improve the Coconut-Beef Cattle Integrated Farming System (Coco-Beef IFS). The integrated crop-livestock farming system represents a key solution for enhancing livestock production and safeguarding the environment through prudent and efficient resource use (IFAD 2009). For this reason, there is need for research on the potential replacement of grasses with legume trees in the Coconut-Beef Cattle Integrated Farming System (Coco-Beef IFS) in South Minahasa, Indonesia

Materials and Methods

The study was carried out in a coconut plantation owned by a farmer goup in South Minahasa Regency, Indonesia. The study aimed to determine the effect of substitution by *Indigofera* sp. replacing *Pennisetum purpureum* cv. dwarf forage as feed for beef cattle.



Photo 1. *Indigofera* sp and *Pennistum purpureum* under coconut trees

The study was with twelve beef cattle (Peranakan Sumba) in a cut-and-carry feedlot system near coconut fields owned by a farmers' group (cooperator farmers). The cattle aged between 18 and 24 months were allotted in groups of 4 animals to three treatments which were ratios of the grass (*Pennisetum purpureum* cv. Dwarf) with the tree legume *Indigofera* sp. as follows: Grass:Indigofera: 100:0, 60:40 and 40:60 (fresh basis). Feeding rate was the equivalent of 3% of live weight (DM basis) an was twice a day with drinking water *ad libitum*. Data on feed intake and live weight change were taken over three months. The effect of the Indigo foliage on live weight gain was determined from the linear regression of live weight gain (Y = kg/d) on the proportion of Indigofera foliage in the diet (X = % fresh basis).

Results and discussion

Fresh *Indigofera* forage production on the land under coconut plants was 31,990 kg/ha/year, less than in the ACIAR (2019) report which was about 50,000 kg/ha/year. Fresh forage production of *Pennisetum purpureum* was 661 t/ha/year,. According to an intake for adult cattle of 40 kg fresh forage per day (Osak et al 2018b), the stocking rate or availability level of *Pennisetum purpureum* per ha of land under coconut trees can be estimated as about 45 animal units (AU) per year.

Table 1. Production of foliage of *Indigofera* sp. and *Pennisetum purpureum*cv on land under coconut trees

	Fresh forage (kg/ha/year)
Indigofera sp.	31,990
Pennisetum purpureum	661,900

There was a linear relationship between the live weight gain of the cattle and the proportion of Indigofera foliage in the diet (Table 2; Figure 1).

Table 2. Average initial live weight, final weight and daily liveweight gain

	Indigofera foliage, % in diet		
	0	**40**	**60**
Initial weight, kg	167	163	168
Final weight, kg	200	205	212
Liveweight gain, kg/d	0.367	0.474	0.494

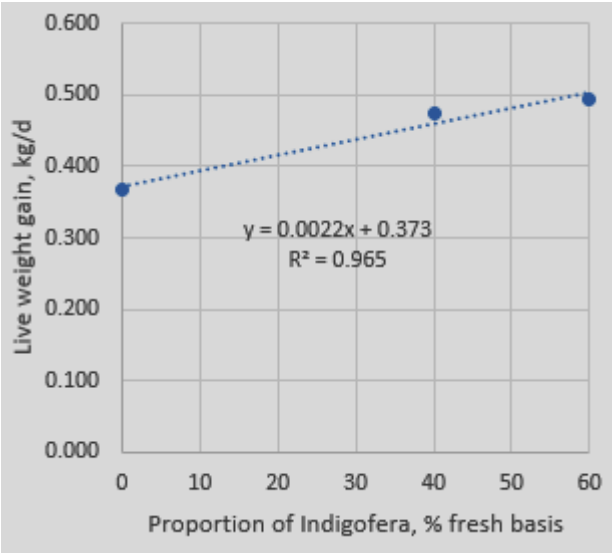


Figure 1. Relationship between live weight gain and replacement of *Pennisetum purpureum by Indigofera* sp in the diet of beef cattle

The best ratio of grass: tree legume was 40:60 on the basis of cattle live weight gain. However, in terms of stocking rate the best ratio was 60:40.

Conclusions

- The best ratio of *Indigofera* tree legume to *Pennisetum purpureum* grass based on cattle liveweight gain was 60:40 fresh basis.
- However, the best ratio based on legume forage availability or stocking rate was estimated o be 40:60.

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