Assessment on pastoral system within oil palm - cattle integrated system to support beef self-sufficiency in North Sumatra

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Abstract. The research was conducted to see the forage production, carrying capacity and rotation cycle that was most suitable for grazing cattle in the ecosystem of oil palm plantations. The research was conducted at Tanah Itam Ulu Oil Palm Plantation, Tanah Itam Ulu Village, Lima Puluh District, North Sumatra from January-December 2017. The research used RCBR consisting of 3 x 3 with 3 replicates. The first factor is the age of oil palm trees (6, 12, 18 years), the second factor is the rotation cycle of forage (40, 50, 60 days). The parameters observed: forage production, cattle capacity, forage nutritional and botanical composition. The research results showed that forage production and carrying capacity had a significantly higher effect (P <0.05) with a harvest interval of 40 days at the location of juvenile oil palm, which was 11,962 kg dry matter/ha/year and carrying capacity was 1.31 AU/ha. Forage quality (protein, NDF and ADF) had no significant effect (P> 0.05). The dominant forage species appeared in almost all observation plots, namely Cyrtococcum and Axonopus. The results of the study concluded that oil palms of 12 years with a harvest rotation of 40 days provided the largest capacity for grazing beef cattle.

1. Introduction
Beef cattle is an important livestock commodity for farmers in North Sumatera. Beef cattle have a function as an economic source as savings that can be sold at any time when large amounts of money are needed. In general, cattle raising in North Sumatra is carried out semi-intensively, that is grazing day and night put in captivity [1]. The oil palm-cattle integration system has long been implemented in North Sumatra. The existence of large oil palm plantation companies such as State owned company (PTPN), private and community plantations plays a major role in supporting the development of the cattle population in North Sumatra. In between the oil palm plantations there is forage as a source of feed for cattle and besides that, cattle produce manure (feces and urine) as organic fertilizer for oil palm plants. This pattern has been going on for a long time and is the cheapest and most efficient way, especially in the provision and provision of feed by the farming community in North Sumatra. Raising beef cattle with an extensive system (grazing) is more profitable because the cost of providing feed is very low compared to an intensive or penned system [2]. [3]. stated that the cost of providing intensive cattle feed reaches 65-75%. This shows that cattle grazing in oil palm plantations will encourage the development of smallholder cattle breeding because it can reduce the cost of providing feed. The area of oil palm smallholders estates of North Sumatra in 2019 is 439,000.08 ha, owned by PTPN II, III and IV of: 256,119.69 ha [4]. This oil palm plantation has the potential to be used as a location for the implementation of the oil palm-cattle integration system with the grazing pattern of cattle in oil palm.
plantsations. Therefore, it is necessary to conduct research to determine forage production to determine the most suitable storage capacity and rotation cycle for grazing and the botanical composition of undergrowth which can be used as a source of cattle feed in the area of oil palm plantations.

2. Materials and methods

The research was conducted at Tanah Itam Ulu Oil Palm Plantation, Tanah Itam Ulu Village, Lima Puluh District, Batubara Regency, North Sumatra Province. The location is located in the lowlands (lk 6 m asl), alluvial soil type, with an average rainfall of 1,376 mm / year. The research period is from January to December 2017.

Oil palm plantations based on age were divided into three groups, namely young (6 years), adolescents (12 years) and old (18 years). Forage harvest rotation cycle consisted of 40 days, 50 days, 60 days. The research used RCBD consisting of 3 x 3 with 3 replications (27 experimental plots).

2.1. Observed variables

Forage production per hectare

\[ P = C \times 10,000 - (LP \times JS) \]

Information:
- \( P \) = forage production per hectare (kg),
- \( C \) = the average weight of forage per m²,
- \( LP \) = the area of the plate on oil palm trees
- \( JS \) = the number of oil palm trees in 1 hectare [5].

Carrying capacity is calculated from the production of forage biomass per cut rotation cycle (40 days, 50 days, 60 days) compared to the animal feed needs of one adult cow / year. The data were processed using a potential analysis methodology according to Ashari et al., (1995).

\[ \text{Carrying capacity} = \frac{\text{Total Feed Availability in DM} \times \text{PUF}}{\text{Total Feed Requirements in DM}} \]

Information:
- DM = dry matter,
- PUF = proper use factor = 60%

The largest carrying capacity then indicates the most suitable livestock density treatment and rotation cycle for each age group of oil palm. The composition of forage nutrients on oil palm plantations was carried out by proximate analysis [6]. to determine the content of moisture, ash, crude protein, NDF and ADF in forages. The botanical composition is determined by the Dry weight Rank method [7] which records the types of forage in the map quadrant of the first quadrant is determined, then data is collected to obtain comparisons between forage species that rank first, second and third. Then each rating is multiplied by a coefficient. First place multiplied by 8.04; second place is multiplied by 2.41 and third place is multiplied by 1.

2.2. Implementation of research

The forage collection of understorey uses the quadratic method measuring 1x1 meter by harvesting the forage with a cut height of 5 cm from the soil surface. The forages in the cut quadrants were marked with a hedge for the next harvest (estimated forage regrowth production per next cycle) every 40, 50, and 60 days for 1 year. The parameters observed were forage production, estimated animal capacity of forage production, forage nutritional composition and botanical composition of forage forage. The forage production from each observation plot was weighed and then oven-dried for 48 hours at 80 °C, after which it was weighed to determine the total dry matter per plot.
3. Results and discussion

3.1. Forage production

The results of forage production obtained at the research location at the age of oil palms with cutting intervals of 40, 50 and 60 days are shown in Table 1.

| Forage harvest rotation cycle (days) | Oil palm plantations based on age | Mean |
|-------------------------------------|----------------------------------|------|
|                                     | 6 years                          | 12 years | 18 years |       |
| 40                                  | 9,608$^b$                       | 11,962$^b$ | 10,509$^b$ | 10,693$^b$ |
| 50                                  | 5,591$^a$                       | 8,483$^a$  | 9,804$^a$  | 8,079$^a$  |
| 60                                  | 6,672$^b$                       | 9,090$^a$  | 9,040$^a$  | 8,267$^a$  |

Production of forage (dry matter) at oil palm plantations based on age 12 years dan 18 years had a significant effect ($P < 0.05$) higher than at the age of young (6 years) oil palm plantations. The forage production in this study was higher than the results of [8], namely that if the oil palm plant was grown as a single crop, the forage that could be produced ranged from 2,800 to 4,800 kg dry matter / ha / year.

Apart from the age factor of oil palms, dry forage production is also influenced by the harvest interval. The productivity of dry forages was significantly higher at the 40 day harvest interval than at the 50 or 60 day harvest interval. However, no interaction effect was seen between the age of oil palm and the harvest interval on dry forage production. The productivity of forages under oil palm ranges from 5,591 kg to 11,962 kg dry forage / ha / year.

3.2. Animal capacity

High forage production causes high capacity as well. The carrying capacity of oil palm land is also influenced by the age of the oil palms and the harvest intervals applied. The carrying capacity at oil palm plantations based on age 12 years (1.09 AU / ha) and 18 years (1.07 AU / ha) had a significant effect ($P < 0.05$) higher than that of 6 years oil palms which provide a capacity of 0.80 UT / ha (Table 2). In contrast to the research results of Daru et al., (2014) stated that the capacity per hectare of oil palm plants at the age of 3 years is 1.44 ST ha-1 and for oil palm plants 6 years old is 0.71 ST ha-1. This is because the oil palms in this study are older (6 years). The animal capacity from forage production oil palm plantation can be seen in Table 2.

| Forage harvest rotation cycle (days) | Oil palm plantations based on age | Mean |
|-------------------------------------|----------------------------------|------|
|                                     | 6 years                          | 12 years | 18 years |      |
| 40                                  | 1.05$^b$                        | 1.31$^b$  | 1.15$^b$  | 1.17$^b$  |
| 50                                  | 0.61$^a$                        | 0.97$^a$  | 1.07$^a$  | 0.89$^a$  |
| 60                                  | 0.73$^a$                        | 1.00$^a$  | 0.99$^a$  | 0.91$^a$  |

The 40-day harvest interval treatment provided a capacity of 1.17 AU / ha which was higher than the other intervals. The carrying capacity of oil palm land with different ages and cutting intervals was quite varied, ranging from 0.61 AU / ha to 1.31 AU / ha.

3.3. Quality forage nutrients available

The results of the analysis of variance showed that only the harvest interval had an effect on forage protein content. The 50-day harvest interval provided 11.65% higher protein content ($P < 0.05$) compared
to the protein content in the 40-day harvest interval treatment (10.01%) or the 60-day harvest interval (10.12%, Table 3). Meanwhile, the protein content is not influenced by the age of the oil palm plantation.

Table 3. Forage protein content (%) forage type according to treatment.

| Forage harvest rotation cycle (days) | Oil palm plantations based on age | Mean |
|-----------------------------------|----------------------------------|------|
|                                   | 6 years                          | 12 years | 18 years |
| 40                                | 11.01\textsuperscript{a}         | 9.48\textsuperscript{a} | 9.53\textsuperscript{a} | 10.01\textsuperscript{a} |
| 50                                | 11.31\textsuperscript{b}         | 12.15\textsuperscript{b} | 11.48\textsuperscript{b} | 11.65\textsuperscript{b} |
| 60                                | 10.38\textsuperscript{a}         | 9.79\textsuperscript{a}  | 10.18\textsuperscript{a} | 10.12\textsuperscript{a} |

The results of the analysis of variance on the forage NDF content showed that there was no influence of the main factor or the interaction between the two. The NDF content varied, ranging from 60.27% to 68.96% (Table 4).

Table 4. Forage NDF content (%) forage type according to treatment.

| Forage harvest rotation cycle (days) | Oil palm plantations based on age | Mean |
|-----------------------------------|----------------------------------|------|
|                                   | 6 years                          | 12 years | 18 years |
| 40                                | 65.34\textsuperscript{a}         | 68.73\textsuperscript{a} | 68.21\textsuperscript{a} | 67.42\textsuperscript{a} |
| 50                                | 61.93\textsuperscript{a}         | 60.27\textsuperscript{a} | 63.93\textsuperscript{a} | 62.05\textsuperscript{a} |
| 60                                | 64.77\textsuperscript{a}         | 68.96\textsuperscript{a} | 63.61\textsuperscript{a} | 65.78\textsuperscript{a} |

The results of the analysis of variance also showed that there was no influence of the main factor or interaction on the green ADF content in oil palm plantations. The NDF content varied from 37.77% to 42.69% (Table 5). The average NDF value in this study was lower than the results of the study [10], the NDF value for forage between oil palms ranged from 66.90-72.13 g / 100g, this was due to different climatic conditions and research locations.

Table 5. Forage ADF content (%) according to treatment.

| Forage harvest rotation cycle (days) | Oil palm plantations based on age | Mean |
|-----------------------------------|----------------------------------|------|
|                                   | 6 years                          | 12 years | 18 years |
| 40                                | 44.04\textsuperscript{a}         | 42.69\textsuperscript{a} | 41.03\textsuperscript{a} | 42.59\textsuperscript{a} |
| 50                                | 40.35\textsuperscript{a}         | 38.10\textsuperscript{a} | 40.50\textsuperscript{a} | 39.65\textsuperscript{a} |
| 60                                | 44.56\textsuperscript{a}         | 40.29\textsuperscript{a} | 37.77\textsuperscript{a} | 40.87\textsuperscript{a} |

3.4. Botanical composition

The types of plants that grow between oil palm plants will be very diverse and are more numerous in areas of young or newly planted oil palms [9]. In the first cutting, the types of forage varied both in terms of number and dominance of forage species. In young oil palms with cutting intervals of 40 days there are 16 types of forage in total, but in the first cut 2 of them dominate, namely grass Cyrtococcum, dan Axonopus (Table 6).

Table 6. Dominant species forage type among Oil palm plantations based on age 6 years

| Forage harvest rotation cycle (days) | Harvest-1 | Harvest-2 | Harvest-3 | Harvest-4 | Harvest-5 |
|-----------------------------------|-----------|-----------|-----------|-----------|-----------|
|                                   | Cyrtococcum | Cyrtococcum | Cyrtococcum | Cyrtococcum | Cyrtococcum |
| 40                                | Axonopus  | Mimosa    | Asystasia | Eluesine  | Eluesine  |
| 16 species                        | 9 species | 14 species | 6 species | 14 species |           |
Although the 2nd dominant forage species generally alternated, Cyrtococcum (Kretekan grass) always appeared the most dominant. This applies to all cutting intervals and at each harvest. In juvenile oil palms with cutting intervals of 40 days there are 8 types of forage overall, but at the initial harvest 2 of them dominate, namely Axonopus grass and Cyrtococcum (Table 7).

Table 7. Dominant species forage type among Oil palm plantations based on age 12 years.

| Forage harvest rotation cycle (days) | Harvest-1 | Harvest-2 | Harvest-3 | Harvest-4 | Harvest-5 |
|-------------------------------------|-----------|-----------|-----------|-----------|-----------|
| 40                                  | Axonopus  | Cyrtococcum | Axonopus  | Axonopus  | Axonopus  |
|                                     | Cyrtococcum | Mimosa  | Desmodium | Desmodium | Desmodium |
|                                     | 8 species  | 7 species | 17 species | 7 species | 15 species |
| 50                                  | Cyrtococcum | Cyrtococcum | Cyrtococcum | Cyrtococcum | Cyrtococcum |
|                                     | Axonopus  | Axonopus  | Axonopus  | Axonopus  | Axonopus  |
|                                     | 11 species | 12 species | 14 species | 10 species | 9 species |
| 60                                  | Axonopus  | Cyrtococcum | Cyrtococcum | Cyrtococcum | Cyrtococcum |
|                                     | Cyrtococcum | Axonopus  | Axonopus  | Axonopus  | Axonopus  |
|                                     | 9 species  | 14 species | 11 species | 10 species | 10 species |

As in young oil palm plantations, kretek grass (Cyrtococcum) and paitan grass (Axonopus) always dominate the forage species under the oil palm plantations. In old oil palms with cutting intervals of 40 days there are 9 types of forage overall, but initially 3 of them dominated, namely Axonopus grass, Mimosa, and Cyrtococcum (Table 8).

Table 8. Dominant species forage type among oil palm plantations based on age 18 years.

| Forage harvest rotation cycle (days) | Harvest-1 | Harvest-2 | Harvest-3 | Harvest-4 | Harvest-5 |
|-------------------------------------|-----------|-----------|-----------|-----------|-----------|
| 40                                  | Axonopus  | Axonopus  | Axonopus  | Axonopus  | Axonopus  |
|                                     | Mimosa  | Cyrtococcum | Cyrtococcum | Cyrtococcum | Cyrtococcum |
|                                     | 9 species | 10 species | 16 species | 14 species | 19 species |
| 50                                  | Axonopus  | Axonopus  | Axonopus  | Cyrtococcum | Cyrtococcum |
|                                     | Cyrtococcum | Cyrtococcum | Cyrtococcum | Axonopus  | Axonopus  |
|                                     | 8 species | 11 species | 15 species | 10 species | 9 species |
| 60                                  | Axonopus  | Axonopus  | Axonopus  | Axonopus  | Axonopus  |
|                                     | Cyrtococcum | Cyrtococcum | Cyrtococcum | Cyrtococcum | Cyrtococcum |
|                                     | 7 species | 11 species | 11 species | 11 species | 9 species |

The types of forage species in this study were less than the results of the study [12], weed species dominating the oil palm plantation ecosystem as animal feed is the poaceae / gramineae family which...
consists of 10 species with 1684 individuals. Apart from the Poaceae family, the two families that had a large number of individuals were the Asteraceae family with 602 individuals and the family of Acanthaceae with 702 individuals. While the few families are Lytheraceae, which is 1 species with 2 individuals. This is because environmental factors also affect the botanical composition in an ecosystem.

4. Conclusions
The grazing pattern of beef cattle in oil palm plantations will be greatly influenced by the availability of feed biomass which varies according to the age of the oil palm. This will determine the level of livestock density and an appropriate rotation cycle. Furthermore, livestock density and rotation cycles will affect the physical, chemical, and biological properties of oil palm plantations and their productivity. The results of the study concluded that young oil palms with a harvest rotation of 40 days provided the largest capacity for grazing beef cattle. For this reason, it is recommended that beef cattle breeding can be carried out in young or old oil palm plantations with a grazing rotation of 40 days.

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