Product as potential of supporting agricultural by large ruminant feed in Bireun Regency

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Abstract. The purpose of this study was to determine the capacity of agricultural crop waste for large ruminants Feed-in Bireun District. This research uses primary and secondary data sources. The observed variables consisted of beef cattle and buffalo population, production of feed crop waste, the requirement for digested dry matter (DDM), and the capacity of the DDM from food crop waste as large ruminant feed. The data is presented descriptively in the form of data processing results from secondary data with previous studies’ results. The beef cattle population in Bireun Regency is 38,151.44 livestock units (LU) and buffalo 1,552 LU. The requirement of forage is 45,261.92 tons of DDM per year. DDM production per year from agricultural crop waste from rice, corn, and soybeans is 63,315.28 tons of DDM per year. The highest production of DDM is derived from rice crop waste amounting to 36,653.68 tons per year, while DDM originated from corn crop waste 3,637.5 tons per year and soybeans 23,024.1 tons per year. The potential of forage feed from food crop waste is 54,901.73 tons of DDM per year and can still be used for 48,159.41 LU. It was concluded that Bireun Regency could increase the population of ruminant animals by increasing the benefits of forage originating from food crop waste.

1. Introduction
Livestock is one of the commodities that can meet food needs and plays an important role in community life growth as a source of animal protein. Some animal protein sources include ruminants such as beef cattle, dairy cows, sheep, buffalo, and goats [1].

Bireuen is one of the central breeding large ruminants such as cows and buffaloes. The cattle and buffalo population in Bireun in 2015 amounted to 65,622 heads, with meat production reaching 972,231 kg [2]. If the population is assumed to require feed as much as 25 kg/head/year, it will require about 1,640.55 tons/year.

Feed is one important factor in the management of livestock breeding. The utilization of agricultural by-products can help farmers overcome the lack of feed, especially during the dry season. Agricultural by-products are the residue or by-products of the main products of food crops.
Agricultural by-products are defined as parts of agricultural plants above or part of shoots, stems that remain after harvest, or the main products are taken [3] and their use as animal feed ingredients that do not compete with humans. The utilization of agricultural by-products as alternative feed is one solution for providing feed for livestock development businesses.

Farmers generally do not take advantage of agricultural by-products because some of them a) farmers will immediately process the land so that food crop waste is burned, b) if it uses agricultural waste, farmers need transportation costs and time, c) need costs for warehouses or agricultural waste storage places, d) Besides, farmers assess that the availability of forage for livestock is still sufficient, obtained from yards, gardens, or rice fields [4].

The development of cattle and buffalo is the government's concern because it can be seen from livestock resources [5,6]. Natural resources, which constitute regional potential, remain the main basis for livestock business activities, especially ruminants. As a feed provider, the linkage between food crop production areas and livestock production becomes essential in the livestock development process. Farmers in Bireun develop cattle using agricultural by-products. Estimates of the production of agricultural by-products produced in supporting the development of cattle are not yet known.

This study aims to determine the potential by-products of food plants as a substitute for ruminant forage in Bireun Regency in the context of developing ruminant livestock. This research is expected to provide important information to the public and breeders in developing ruminants by utilizing food crop by-products as a substitute for forage.

2. Materials and methods

2.1. Place and time of the research
The study was conducted from January to December 2018 in Bireun District, Aceh Province.

2.2. Type and data collection
The study's location was purposive sampling, considering that some farmers/breeders in Bireun District have used agricultural by-products. The method of analysis used in this research is the descriptive research method with a quantitative approach. Data sources are primary data and secondary data. Secondary data were obtained from the Livestock Service Office, Food Crops and Horticulture Service, and the Central Bureau of Statistics in livestock population and the area and production of food crops data. Based on secondary data, the calculation of the number of livestock units, the production of food crop waste, and livestock capacity will be calculated. Other supporting data relating to this research was obtained from study reports or studies and various other literature resources.

2.3. Observed variables
The observed variables include;

(1) The population of large ruminants, namely beef cattle, and buffalo is located in a sub-district in Bireun District using the Livestock Unit (ST) calculation unit. Data on the population of large ruminants was obtained from the Livestock Service Office of Bireun District in 2018. Meanwhile, data on the population of large ruminants is calculated based on the production level (weaning, off weaning, young, adult, and imported cattle). The estimated value is based on [7]. States that the structure of beef cattle population based on age is (a) Weaners with age <1 year have a composition of 19.30% of the population; (b) Off weaning > 1 year old has a composition of 25.85% of the population; (c) Young people aged 2-4 years have a composition of 18.15%; (d) Adults > 4 years old have a composition of 26.89%; and (e) Imported cattle have a composition of 9.81%. Furthermore, the beef cattle population based on age was converted into Animal Units (ST) using the [8]. The unit value of beef cattle according to [8] is 0.25 ST for calves (weaning and off weaning), 0.6 ST (young), and 1.00 (adult and imported). The unit value of buffalo is calculated according to [9], precisely 0.88 ST.
(2) The minimum need for forage for large ruminants using the calculation of [10], which is 1.14 tonnes DDM / year.

(3) The estimated production of food crop waste per hectare per year is calculated based on the estimated production from the Food Crops and Horticulture Service of Bireun Regency and was calculated according to [10].

(4) Area and production of pasture grass [11]

3. Results and discussion

Bireuen District is one of the central areas for beef cattle production in Aceh Province. This district is very strategic in developing beef cattle because it is supported by grazing land and cattle population in each sub-district [12]. The beef cattle productivity is necessary to implement a strategy for providing feed through the optimization of local resources, such as increasing the use of productive land and processing site-specific agricultural by-products to meet livestock needs for forage [13].

The Bireun Regency has 64,798 cows, 1,940 buffalo, 36,537 goats, and 16,672 sheep. The potential of each sub-district, where there are 13,304 cattle breeders, 698 buffalo breeders, seven units of RPH, eight units of IB Post, 17 livestock officers, 14 IB officers, 23 independent IB officers, nine units of animal health posts, 11 medical officers, and 14 paramedics. The cattle importers from Sumatra Utara Province, District Pidie, Aceh Tengah, Aceh Utara, Aceh Timur, Aceh Besar, Bener Meriah, as many as 24,741 heads [11], and the percentage of IB is 191, 178% pregnancy and 77% birth [11].

Table 1 shows the population of cattle and buffalo in the Bireun regency. The highest beef cattle population was in Peusangan District with a total of 5,546 heads, and the lowest was in Pandrah District with 1,734 heads. The Peudada District is an area with a population of 284 buffaloes, and the lowest is in term district, namely one head. beef cattle development requires area grouping that is adjusted to the forage carrying capacity [14, 15, 16, 17]. One of the factors of production that determines the fulfillment of beef needs is the availability of beef cattle for sustainable development of breeding. [18] added that the central region is a determining factor in economic development. The commodity zoning system is expected to increase the efficiency of the commodity production and distribution system. It is an effort to maximize each region's comparative advantage. The availability of service facilities greatly determines beef cattle's development because it is related to their distribution. Facilitation of service units such as the development of slaughterhouses with operational standards so that in the future, Bireun Regency can meet the need for safe, healthy, whole, and halal. The industrial development is engaged in diversifying processed beef products, and improving the quality of processing waste and other waste has added value by involving smallholder, and private breeders, strengthening the supporting aspects of technology and institutions to support beef cattle development is needed.

Table 2 shows the amount of food crop production by sub-district in the Bireun district. Increasing livestock population and productivity are strongly supported by the availability of available feed. Apart from pasture land, the ruminant animal feed can be obtained from food plant waste. The potential carrying capacity of food crop waste as a fiber source in the form of rice straw, corn straw, and soybean straw can be estimated. Estimates of the production of rice straw, corn straw, and soybean straw are shown in table 2. the largest number of rice plants in the Peusangan sub-district is 25,684 ha, the lowest is in the Peusangan sb Krueng District, which is 1,049 ha. Jeumpa Subdistrict dominates the maize crop by 6,500 ha, and the lowest is in Samalanga sub-district 7 ha. The largest soybean plant is in Jeumpa Sub-district with 62,570 ha, and the lowest is in Peusangan Selatan District at 5.4 ha. Several advantages can be taken by raising ruminants, among others, to utilize the remaining agricultural products in large enough quantities [19].
Table 1. The population of beef cattle and buffalo by age and conversion to livestock unit (ST).

| District      | Beef Cattle Population (head) | Population of weaned calves (head) | Population of weaner cattle (head) | Population of growing beef cattle (head) | Population of mature beef cattle (head) | Imported beef cattle population (head) | Total beef cattle population (LU) | Buffalo population (LU) |
|---------------|-------------------------------|-----------------------------------|-----------------------------------|------------------------------------------|----------------------------------------|-----------------------------------|------------------------------|-------------------------|
| Samalanga     | 1835.00                       | 354.16                            | 474.35                            | 333.05                                   | 493.43                                 | 180.01                            | 1080.40                     | 24.00                   |
| Sp. Mamplam   | 4359.00                       | 841.29                            | 1126.80                           | 791.16                                   | 1172.14                                | 427.62                            | 2566.47                     | 188.00                  |
| Pandrah       | 1734.00                       | 334.66                            | 484.28                            | 341.72                                   | 466.27                                 | 170.11                            | 1020.94                     | 180.00                  |
| Jeunieb       | 3386.00                       | 653.50                            | 875.28                            | 614.56                                   | 910.50                                 | 332.17                            | 1993.59                     | 148.00                  |
| Peulimbang    | 2383.00                       | 459.92                            | 616.01                            | 432.51                                   | 640.79                                 | 233.77                            | 1403.05                     | 186.40                  |
| Peudada       | 4212.00                       | 812.92                            | 1088.80                           | 764.48                                   | 1132.61                                | 413.20                            | 2479.92                     | 227.20                  |
| Juli          | 5830.00                       | 1125.19                           | 1507.06                           | 1058.15                                  | 1567.69                                | 571.92                            | 3432.56                     | 100.80                  |
| Jeumpa        | 3846.00                       | 742.28                            | 994.19                            | 698.05                                   | 933.82                                 | 377.29                            | 2264.43                     | 42.40                   |
| Kota Juang    | 3011.00                       | 581.12                            | 778.34                            | 546.50                                   | 809.66                                 | 377.29                            | 2172.80                     | 69.60                   |
| Kuala         | 3575.00                       | 689.98                            | 924.14                            | 648.86                                   | 961.32                                 | 350.71                            | 2104.87                     | 59.20                   |
| Jangka        | 4439.00                       | 856.73                            | 1147.48                           | 805.68                                   | 1193.65                                | 435.47                            | 2613.57                     | 0.80                    |
| Peusangan     | 5564.00                       | 1073.85                           | 1439.28                           | 1009.87                                  | 1496.16                                | 545.83                            | 3275.94                     | 7.20                    |
| Peusangan Selatan | 5103.00                  | 984.88                            | 1319.13                           | 926.19                                   | 1372.20                                | 500.60                            | 3004.52                     | 104.00                  |
| Peusangan Sh Krueng | 3956.00              | 763.51                            | 1022.63                           | 718.01                                   | 1063.77                                | 388.08                            | 2329.19                     | 58.40                   |
| Makmur        | 2665.00                       | 514.35                            | 688.90                            | 483.70                                   | 716.62                                 | 261.44                            | 1569.09                     | 14.40                   |
| Gandapura     | 5145.00                       | 992.99                            | 1329.98                           | 933.82                                   | 1383.49                                | 504.72                            | 3029.25                     | 45.60                   |
| Kuta Blang    | 3755.00                       | 724.72                            | 970.67                            | 681.53                                   | 1009.72                                | 368.37                            | 2210.85                     | 96.00                   |
| **Total**     | **64798.00**                  | **12506.01**                      | **16750.28**                      | **11760.84**                             | **17424.18**                           | **6356.68**                      | **38151.44**                | **1552.00**             |

Notes: 1) Livestock Service Office of Bireun Regency (2018); 2) data is processed based on population-based on age according to the Directorate General of PKH (2012); 3) processed data for the total population of beef cattle in ST according to Nell & Rollingson (1974) 4) data processed based on Thahar and Mahyudin (1993) in Sumanto and Juraini (2006)

Table 2. Total production of food crops and grass waste (BKC ton / yr) in Bireun Regency, 2018.

| District      | Rice   | Maize  | Soy bean | Green bean | Peanut | Sweet potatoes | Cassava    | Grass | Total Waste Production (DMD ton /hmn) |
|---------------|--------|--------|----------|------------|--------|----------------|------------|-------|--------------------------------------|
| Samalanga     | 2,774.38 | 2.1    | 0        | 2.16       | 3.29   | 62.1           | 46.13      | 26827.5 | 30,388.54                           |
| Sp. Mamplam   | 3,147.62 | 4.8    | 0        | 0          | 16.44  | 183.6          | 208.58     | 28035  | 29,966.36                           |
| Pandrah       | 1,915.48 | 0      | 0        | 0          | 0      | 0              | 15.88      | 6045   | 8,955.76                            |
| Jeunieb       | 2,868.18 | 2.4    | 0        | 0          | 0      | 0              | 40.18      | 52875  | 54,165.60                           |
| Peulimbang    | 1,282.82 | 0      | 0        | 0          | 0      | 0              | 7.78       | 56575  | 59,835.76                           |
| Peudada       | 3,034.36 | 189    | 0        | 0.43       | 0      | 20.93          | 16.04      | 57150  | 59,259.81                           |
| Juli          | 914.76   | 1,015.2 | 0       | 2.68       | 3.01   | 0              | 7.78       | 179375 | 20,4372.21                          |
| Jeumpa        | 2,532.82 | 1,950   | 20,648.1 | 0         | 1.97   | 0              | 64.31      | 157800 | 158,786.53                          |
| Kota Juang    | 957.74   | 3.3     | 0        | 1.32       | 0      | 0              | 24.18      | 61190  | 63,221.84                           |
| Kuala         | 1,947.54 | 0      | 0        | 4.11       | 0      | 0              | 80.19      | 3600   | 6,532.23                            |
| Jangka        | 2,916.62 | 0      | 0        | 0          | 0      | 0              | 15.61      | 4560   | 8,269.41                            |
| Peusangan     | 3,595.76 | 9      | 0        | 0          | 0      | 0              | 104.65     | 4675   | 6,016.25                            |
Peusangan Selatan | 1,088.36 | 123 | 0 | 1.51 | 0 | 0 | 128.39 | 63250 | 66,102.54
Peusangan Sb Krueng | 146.86 | 289.5 | 2,376 | 0 | 0 | 0 | 40.18 | 77775 | 79,706.88
Makmur | 1,883.42 | 24 | 0 | 0.41 | 0 | 0 | 85.05 | 48000 | 50,521.76
Gandapura | 2,014.88 | 19.8 | 0 | 0 | 0 | 0 | 24.06 | 15750 | 80,444.81
Kuta Blang | 2,516.36 | 5.4 | 0 | 0 | 0 | 0 | 0 | 894482.5
Total | 36,653.68 | 3,637.5 | 23,024.1 | 12.22 | 25.12 | 266.63 | 1075.57 | 894482.5

Source: Department of Agriculture of Bireun Regency (processed data), 2018

According to [20], Indonesia has become one of the countries with the richest biodiversity globally; it is called one of the biggest biodiversity countries, one of which is Aceh Province. Agricultural by-products are potential local feed to support livestock development, especially in agriculture-based areas such as Bireun District, using rice straw, corn straw, and soybean straw. One of the problems faced by breeders in developing a livestock business is feed. Crop cultivation will have implications for increased production of by-products (waste). These food plants' by-products can be used as a substitute for forage, whose availability is increasingly limited.

One of the important factors causing beef cattle's low population and productivity is the low quality of feed [21]. The production of agricultural by-products is highly dependent on harvest time, resulting in unsustainable availability throughout the year so that storage is needed to accommodate agricultural by-products at harvest [22]. Development of livestock areas integrated with other sub-sectors can take advantage of by-products such as agricultural by-products [23]. Thus, food crop by-products are one solution for plants found in agricultural land used as a substitute for forage for ruminants.

According to [24] stated that crude fiber in feed ingredients has a major effect on digestibility. The lower the crude fiber, the higher the ratio's digestibility, but the crude fiber is very important for ruminants as an energy source. [25] added that the quality of a feed ingredient is determined by its nutritional content and is primarily determined by the degradation and adaptability of rumen microbes. It affects feed digestibility, especially lignin content. Factors that influence feed digestibility include the chemical composition of feed ingredients, ration composition, physical form of ration, feeding rate, and internal factors of livestock [26]. Feed ingredients have high digestibility if they contain easily digestible nutrients [27]. The main problem encountered in the ruminant livestock business is the unavailability of continuous feed with good quality. Efforts are made by storing, preserving, and improving the quality or nutritional value through the touch of feed technology [28], using fermentation. Fermentation technology is entirely appropriate to do because it can increase the nutritional value and be stored for a long time to overcome feeding difficulties in the dry season [29] and improve palatability and digestibility [30]. Another potential that Bireun district possesses is the existence of grazing fields and natural grass scattered in all districts in fertile conditions that can be used as ruminant animal feed. The area of pasture facilities and natural grass is the largest in the District of Bireun in the sub-district of Juli, amounting to 287 ha with a production of 71750 tonnes/year in fertile conditions, and the lowest in the District of Term is 12 ha with a production of 1824 tonnes/year with less fertile conditions. [31] stated that tree legume forage is a widely available animal feed commodity and does not depend on the season in tropical countries such as Indonesia.

The use of forage as ruminant feed is to meet the need of crude fiber. The introduction of forage protein sources derived from grass and legumes in pasture areas is important in providing cheap and easy feed and quantity and quality [32,33] and continuity [34]. Complete feeding can increase body weight gain and increase cattle selling value [35]; however, prevention is needed so that the livestock population does not exceed its carrying capacity. [36], adding that livestock populations that exceed the carrying capacity of land resources that continue continuously without prevention will result in land degradation and reduced availability of forage; thus, actions are needed to increase land carrying capacity such as efficiency. [37] added that natural forage could be found in natural grazing areas and
in various areas of vacant land, which intentionally or unintentionally have the potential to provide natural forage. The nutritional content of natural grass is 24.4% dry matter, 14.5% ash, 8.2% crude protein, 1.4% crude fat, 3.7% crude fiber, 44.2% nitrogen-free extract material and total digestible nutrient 56.2% [38].

Table 3 shows that beef cattle’s total population is 38151.44 AU and buffalo 1.552 AU, requirement forage is 45,262 ton DDM/year. The total availability from crop waste is 63,315.28 ton DDM/year consist of rice plants 36,653.68 ton DDM/year, corn 3,637.5 ton DDM/year, and soybeans 23,024.1 ton DDM/year. The number of livestock shows in table 3 can still be increased by utilizing food crop waste. From the total population of cattle and buffalo, food crop waste availability is still very supportive of population growth.

Table 3. The population of beef cattle and buffalo based on livestock units need for feed and capacity to accommodate food crop waste.

| District         | Beef Cattle Population (ST) | DMD Requirement of beef cattle (ton/year) | Buffalo population (ST) | DMD Requirement of buffalo (ton/year) | Total requirement of DMD (ton/year) | DMD production (ton/year) | The potential of DMD has not been utilized (ton/year) | Carrying capacity (LU/year) |
|------------------|-----------------------------|-------------------------------------------|--------------------------|---------------------------------------|-----------------------------------|--------------------------|------------------------------------------------------|-----------------------------|
| Samalanga        | 1080.40                     | 1231.66                                   | 24                       | 27.36                                 | 1259.02                           | 30388.54                 | 29129.40                                            | 25552.21                    |
| Sp. Mamplam      | 2566.47                     | 2925.78                                   | 188                      | 214.32                                | 3140.10                           | 29966.36                 | 26826.26                                            | 23531.81                    |
| Pandrah          | 1020.94                     | 1163.87                                   | 180                      | 205.2                                 | 1369.07                           | 8955.76                  | 7586.69                                             | 6654.99                     |
| Jeunieb          | 1993.59                     | 2272.70                                   | 148                      | 168.72                                | 3441.42                           | 54165.60                 | 51724.18                                            | 45372.09                    |
| Peulimbang       | 1403.05                     | 1599.48                                   | 186.4                    | 212.496                               | 3875.97                           | 59835.76                 | 58023.78                                            | 50898.05                    |
| Peudada          | 2479.92                     | 2827.11                                   | 227.2                    | 259.008                               | 50295.81                          | 35255.45                 | 29725.17                                            | 49275.17                    |
| Juli             | 3432.56                     | 3913.12                                   | 100.8                    | 114.912                               | 4028.03                           | 204372.21               | 200344.18                                           | 175740.51                    |
| Jumpha           | 2264.43                     | 2581.45                                   | 42.4                     | 48.336                                | 2629.78                           | 158786.53               | 156156.75                                           | 136979.6                     |
| Kota Juang       | 1772.80                     | 2020.99                                   | 69.6                     | 79.344                                | 2100.34                           | 63221.84                | 61121.50                                            | 53615.35                    |
| Kuala            | 2104.87                     | 2399.55                                   | 59.2                     | 67.488                                | 2467.04                           | 6532.23                  | 4065.19                                             | 3565.95                     |
| Jangka           | 2613.57                     | 2979.47                                   | 0.8                      | 0.912                                 | 2980.38                           | 8269.41                 | 5289.03                                             | 4639.50                     |
| Peusangan        | 3275.94                     | 3734.58                                   | 7.2                      | 8.208                                 | 3742.78                           | 6016.25                 | 2273.47                                             | 1994.27                     |
| Peusangan Selatan| 3004.52                     | 3425.15                                   | 104                      | 118.56                                | 3543.71                           | 66102.54                | 62558.82                                            | 54876.16                    |
| Peusangan Sb Kraueng| 2329.19                 | 2655.28                                   | 58.4                     | 66.576                                | 2721.86                           | 79706.88                | 76985.03                                            | 67530.72                    |
| Makmar           | 1569.09                     | 1788.76                                   | 14.4                     | 16.416                                | 1805.17                           | 53119.73                | 51314.56                                            | 45012.77                    |
| Gandapura        | 3029.25                     | 3453.34                                   | 45.6                     | 51.984                                | 3505.33                           | 50521.76                | 47016.43                                            | 41242.49                    |
| Kuta Blang       | 2210.85                     | 2520.37                                   | 96                       | 109.44                                | 2629.81                           | 80444.81                | 77815.01                                            | 68258.78                    |
| Total            | 38151.44                    | 43492.64                                  | 1552.00                  | 1769.28                               | 45261.92                          | 894482.5                | 849220.58                                           | 744930.33                    |

Source: Department of Agriculture of Bireun Regency (processed data), 2018.

4. Conclusions
The total beef cattle population is 38151.44 AU and buffalo 1552 AU; the requirement forage is 45,262 ton DDM / year. The total availability from crop waste is 63,315.28 ton DDM / year consist of rice plants 36,653.68 ton DDM/year, corn 3,637.5 ton DDM/year, and soybeans 23,024.1 ton DDM/year. The untapped potential of DDM as animal feed is 54,901.73 tons per year and can be utilized by 48,159.41 AU of new livestock. Another potential feed forage from pasture with wide 1563
ha and 357,793 ton/year production infertile conditions. It is concluded that Bireun regency can increase the population of ruminants by increasing the benefits of forage feed from food crop waste.

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