Inventory And Mapping Of Food Crops Waste As Livestock Feed Resources In The Development Of Beef Cattle In Majene District, West Sulawesi Province

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Abstract: This study aims to inventory and map food crop waste as livestock feed for the development of beef cattle in Majene district. The intended food crop waste is of rice straw, corn straw, sweet potato straw, peanut straw, green beans straw and cassava leaves The parameters studied are 1). Production of food crop waste. 2). Feed carrying capacity from food crops waste. 3). Location Question Analysis (LQ). This study uses a survey method and analyzes the nutritional quality of food crop waste carried out at the Hasanuddin University Faculty of Animal Husbandry Nutrition and Animal Feed Laboratory. The results showed that in Majene Regency, the area that had the potential for the development of beef cattle was divided into cattle distribution area (WS) groups, namely Sendana, Tammerodo, Malunda and Ulumanda Districts. Development area group (WP), namely Banggae District, East Banggae, Pamboang and Tubo. It is expected that the establishment of beef cattle breeding business areas should be carried out in areas that have the potential in terms of region, livestock and feed carrying capacity in the form of food crop waste.

Keywords: Inventory and Mapping, Livestock, Development Beef Cattle.

1. INTRODUCTION

Food crop waste is potent local food to support livestock development especially in agriculture-based areas such as Majene Regency. Among them are the use of rice straw, corn straw, sweet potato straw, peanut straw, green bean straw and cassava leaves (Khan, et al, 2013). One of the problems faced by people's livestock to develop livestock business is feed (Steinfeld, 2006). Food crop agriculture will have implications for increasing waste production. The food crop waste can be used as a substitute forage feed, whose availability is increasingly limited. Thus, the utilization of food crop waste is one solution to overcome the shortage of forage primarily as a forage substitute feed for ruminants.[1][2]Several factors hinder the provision of forage, namely the change in function of land previously as a source of forage into residential land, land for food crops and industrial crops (Assefa, et al, 2015). Besides that, in general the availability of forage is also influenced by climate (Egeru, et al., 2015), so that in the dry season there is a shortage of forage and vice versa during the rainy season there is a large amount of animal feed.Majene Regency has the potential to produce agricultural and livestock commodities.[3][4] The area of Majene Regency is 947.8 Km² / 94,780 Ha and around 10% of the area is food crops planted with rice as a mainstay food crop, while other food crops produced are corn, peanuts, green beans, sweet potatoes and cassava (Central Statistics Agency, 2017). Thus food crop agriculture will have implications for the increased production of waste that can be produced from all these commodity crops.[5] Food crop waste is a fibrous feed resource suitable for cattle and other ruminants (Herrero, et al, 2013). In many regions, food crop wastes such as rice straw have not been used as sources of animal feed. Farmers tend to burn it, which means removing potential organic material (Sabiiti, 2011).[6][7]Increased livestock production must be balanced with the provision of continuous, quality food throughout the year (Renaudeau, et al 2011). Local feed ingredients based on food crop waste can be used as a source of feed ingredients, but this potential has not been utilized properly and optimally due to the lack of accurate data and information about the amount and availability (Case, DO. 2007). Most of the components of agricultural crops can be used as animal feed which is then commercialized into feed ingredients with high nutritional value (Devendra et al, 2011).[8] This food crop waste can produce dry matter as a feed material for energy sources of beef cattle (Derseh, B. 2013).[9] To find out the availability of beef cattle feed ingredients in an area, inventory is needed (West, Pc, et al, 2014). This is important to build an information system for developing beef cattle. With this information system, efforts can be made to optimize the use of locally available feed ingredients so that they can meet the standards of livestock needs. The main input from livestock is feed (Bonauda, et al., 2014) and the livestock itself so that in the development of livestock businesses, including beef cattle, they must pay attention to these two input elements (Bell, Moore, 2012). This means that a region is said to have the potential if feed inputs are available locally both quantitatively (Alizadeh, Silva 2013), and the quality supports the development of the livestock itself so that in the long term livestock business, especially beef cattle business, can show optimal performance. The potential of regional carrying capacity for livestock can be concentrated on the ability of the region to accommodate a number of livestock including the ability to produce animal feed so that livestock can breed and produce according to the agroecosystem of each region (Moraes, et al, 2014). In this case it can be distinguished into real carrying capacity that can be used now and potential carrying capacity where there is potential for animal feed production that can be developed, cultivated and processed by applying available feed technology. Along with the carrying capacity of the region for the development of beef cattle in Indonesia, the carrying capacity of the region as a source of animal feed is also an integral part that cannot be separated (Lemaire et al, 2013). The benefits of the study become information material for planning regional strategic policy formulation in terms of the utilization of food crop waste as animal feed and the development of beef cattle.[10] [11]

2. METHODOLOGY

Place and time of research.
The research was conducted in April to November in Majene Regency, West Sulawesi Province and an analysis of the quality of animal feed was carried out at the Hasanuddin University Animal Husbandry Nutrition and Feed Laboratory. This study uses a survey method. The survey method used in this study was purposive sampling. Purposive sampling is a sampling method that is based on certain goals and considerations of the researcher.

Data source.
The data used in this study is based on primary data, namely data obtained from surveys to the field and secondary data obtained from relevant agencies such as the Livestock Service Office, Food Crops and Horticulture Service, Regional Development Planning Agency and Central Statistics Agency. Other supporting data relating to this research were obtained from study reports or studies and various other library sources. According to the Director General of Animal Husbandry and Animal Husbandry UGM (1982) that rice, green beans, peanuts and sweet potatoes were carried out by 2.5 x 2.5 m² with 3 replications, maize and cassava were made 5 x 5 m² with 3 times repeat,

Data analysis.
Survey of Food Crop Waste and Quality of Food Crop WasteFood crop waste survey aims to take samples from each waste that will be used in this study. Production of food crop waste is known by taking the seeds of each commodity that will be studied. Proximate analysis was used to determine the quality of each waste which included analysis of dry matter, crude fat, crude fiber, crude protein, extract material without nitrogen and ash. Analysis of feed ingredients was carried out at the Animal Husbandry Nutrition and Food Laboratory of the Faculty of Animal Husbandry, Hasanuddin University.

Production of Food Crop Waste and Carrying Capacity from Food Crop Waste.
The production of food crop waste is calculated based on Dry matter production (DM), Coarse Protein production (CP) and the production of Total Degestible Nutrient (TDN) on the harvested area of each waste. TDN is calculated using the summative equation (NRC, 1985) based on the proximate content of each food crop as follows:

$$\%\,TDN = 92.464 - 3.338\,(CF) - 6.945\,(CF) - 0.726\,(BETN) + 1.115\,(CP) + 0.031\,(CF)^2 - 0.133\,(CF)^2 + 0.0036\,(CF)(BETN) + 0.207\,(CF)\,(BETN) + 0.100\,(CF)(CP) - 0.022\,(CF)^2(CP)$$

*CF (Crude Fiber), CF (Crude Fat), CP (Crude Protein), BETN (Extract Material without Nitrogen).

The calculation of the total production of food crop waste is as follows:

1. Total Fresh Production (tons) = fresh production (tons / ha) x harvested area (ha).
2. Dry matter total production (tons) = total fresh production (tons) x dry matter content (%).
3. Total Crude Protein Production (tons) = Total dry matter production (tons) x content crude protein (%).
4. Total TDN Production (tons) = Total dry matter production (tons) x TDN Content (%).

The Carrying Capacity of Food Crop Waste (CCFCW)
The CCFCW was the capability of a region to produce feed in the form of food crop waste without processing, and could provide feed to accommodate a number of ruminant livestock populations. Calculating CCFCW was used by several assumptions on ruminant feed requirements. The assumptions used were that one livestock unit (1 Animal Unit) ruminants requires an average DM of 6.25 kg/day, CP needs of 0.66 kg/day, and TDN needs of 4.3 kg/day (NRC, 1985). CCFCW was calculated based on the following formulas according to Riethmuller, 1999.

$$\text{CCFCW based on DM} = \frac{\text{Production of DM (ton/ year)}}{\text{1 AU of DM Need (tons/year)}}$$

$$\text{CCFCW based on CP} = \frac{\text{Production of CP (tons/year)}}{\text{1 AU of CP Need (tons/year)}}$$

$$\text{CCFCW based on TDN} = \frac{\text{Production of TDN (tons/year)}}{\text{1 AU of TDN Need (tons/year)}}$$

Location Quotient Analysis (LQ) with a formula according to (Kurniawan , 2014), namely:

$$LQ = \frac{pi / pt}{Pi / pt}$$

Pi = first livestock population at sub-district level
Pt = total population of livestock groups at the sub-district level
Pi = 1st livestock population at the district level
Pt = total population of livestock groups at the district level

The capacity of increasing cattle population (CICP) is calculated as the difference between the carrying capacity of the feed both from food crop waste and the available number of cattle (Syamsu et al., 2006).

3. RESULT AND DISCUSSION

Results.
Proximate analysis was carried out to determine the quality of each food crop waste which included analysis of dry matter, crude fat, crude fiber, crude protein, extract material without nitrogen and ash. The proximate analysis of food crop waste can be seen in table 1.

Table 1. *Proximate Analysis of Food Crop Waste in the Laboratory of Nutrition and Animal Feed, Faculty of Animal Husbandry, Hasanuddin University (2018).*

types of food crop waste	Analysis Result (%)*					
	WC*	CP *	CFat*	CF*	Ash*	BETN*
Rice straw	9.28	4.71	3.01	33.18	20.19	38.91
Corn straw	14.36	8.58	1.95	37.49	12.88	39.10
Peanut straw	12.75	21.01	4.66	15.01	9.36	49.96
Straw green beans	11.05	16.12	3.92	20.92	13.12	45.92
Sweet potato leaves	12.49	10.56	3.44	23.76	14.33	47.91
Cassava leaves	10.20	23.98	2.87	21.85	44.60	6.70

**WC= water content, CP(Crude Protein), Cfat(Crude fat), CF (Crude Fiber), BETN (Extract material without nitrogen)*

Carrying Capacity of Food Crop Waste as a Source of Beef Cattle Feed The production of food crop waste is obtained from the calculation of the area of rice, maize, soybean, peanut, cassava, sweet potato (Departement of agricultural, Livestock and Plantation, 2017) multiplied by the production of dry matter (DM) tons / ha of straw / agricultural waste . For

agricultural production based on Total Digestible Nutrient (TDN) and crude protein (CP) obtained from dry matter production multiplied by TDN content and CP of each agricultural waste.

Table 2. *Carrying Capacity of Food Crop Waste as a Source of Beef Cattle Feed in Majene Regency.*

Sub-district	Production(ton)			Carrying capacity (AU)		
	DM	CP	TDN	DM	CP	TDN
Banggae	1098.23	249.315	749.99	175.68	377.75	255.40
Banggae Timur	4081.76	3116.65	2104.28	653.08	6184.48	949.25
Pamboang	5835.5	643.3	1107.4	933.68	8841.66	1357.09
Sendana	30557.0	18507.6	13694.9	4889.12	46298.5	7106.27
Tammerodo	12033.1	7846.1	5833.6	1925.29	18231.8	2798.39
Tubo	4799.8	2711.7	2228.0	767.97	7272.42	1116.23
Malunda	42927.0	24281.7	19489.3	6868.32	65040.9	9983.0
Ulumanda	58051.0	31957.0	8652.2	9288.16	87956.0	13500.2
Jumlah				25501.3	240203.51	37065.83

Source: Results of primary data processing (2019)

**DM (dry matter), CP (crude protein), TDN (total digestible nutrient),*

From the table, it can be seen that the carrying capacity of food crop wastes in Majene regency can accommodate and provide feed for the needs of beef cattle based on the calculation of dry matter (DM) which is equal to 25501.3 Animal Unit (AU). If it is associated with a cattle population of 15957.0 Animal Unit (AU), then in Majene Regency the carrying capacity of food crop waste is very sufficient for beef cattle feed needs and it is even possible to increase the population of 9544.3 beef cattle Animal Unit. Ulumanda District is a sub-district that has the highest carrying capacity of 9288.16 Animal Unit (AU).

The capacity of increasing cattle population (CICP)

The capacity of increasing cattle population (CICP) is calculated as the difference between the carrying capacity of the feed both from food crop waste and the available number of cattle.

Table 2*. Capacity for Increasing Beef Cattle Population*

Sub district	Carrying capacity (AU)			Number of cattle population	Capacity for increasing beef cattle production		
	DM	CP	TDN		DM	CP	TDN
Banggae	175.68	377.75	255.40	602	-426.32	-224.25	-346.6
Banggae Timur	653.08	6184.48	949.25	1160	-506,92	5024.0	-210.75
Pamboang	933.68	8841.66	1357.09	3099	-2165.32	5742.66	-1741.91
Sendana	4889.12	46298.5	7106.27	5767	-877.88	40531.5	1339.27
Tammerodo	1925.29	18231.8	2798.39	553	1372.29	17678.8	2245.39
Tubo	767.97	7272.42	1116.23	1171	-403.03	6101.42	-54.77
Malunda	6868.32	65040.9	9983.0	3180	3688.32	61860	6803
Ulumanda	9288.16	87956.0	13500.2	425	8863.16	87531.0	13075.2
Jumlah	25501.3	240203.51	37065.83	15957			

Source: Results of primary data processing (2019)

Beef Cattle Development Base Area

To determine the base area for developing beef cattle, a data series of beef cattle population is needed for a period of 5 years. The main data sources used are secondary data from the Department of Agriculture, Animal Husbandry and Plantation of Majene Regency. The average number of population according to the type of livestock from each group of ruminants and not ruminants is calculated on average, the results obtained are given the notation "pi". Furthermore, the total population value of each in each region (horizontal addition) according to each sub-sector. The results show the number of livestock populations which are then given a "pt" notation. Sum up livestock populations vertically by region. This addition results in the total livestock population of each region given the "Pi" notation. Furthermore, add the number of livestock populations from all regions which are then given the "Pt" notation.

Table 2*. Beef Cattle Development Base Area with a value of LQ≥1 and LQ <1 in Majene District.*

	Districts	LQ value
1	Banggae	0,97
2	Banggae Timur	0,95
3	Pamboang	0,99
4	Sendana	1,01
5	Tammerodo	0,99
6	Tubo	1,00
7	Malunda	1,00
8	Ulumanda	1,02

source: results of data processing 2019

The LQ value obtained will be in a range smaller or equal to one to greater than number 1, or 1> LQ> 1. The magnitude of the LQ value indicates the magnitude of the degree of specialization or concentration of the commodity in the relevant region relative to the reference region. This means that the greater the LQ value in an area, the greater the degree of concentration in the region. The base area for developing beef cattle in Majene Regency is LQ memiliki1, including Sendana, Tubo, Malunda and Ulumanda sub-districts. Banggae, East Banggae, Pamboang and Tammerodo sub-districts are areas that are non-bases for developing beef cattle.

DISCUSSION.

To improve the livestock business, the first attempt was to look at the condition of the availability of animal feed in the area (Khan et al, 2013), then to develop the beef cattle itself, including the population. By that, to increase livestock business, selected areas worth CIBCP are positive food waste because of the potential for increasing livestock populations and still having forage supplies in the form of food crop wastes (Lisson et al, 2010) which states that the capacity for increasing he population of ruminants is very sufficient and can be added to a number of beef cattle populations.Majene Regency, which consists of 8 sub-districts, has 4 sub-districts which have positive capacity for increasing beef cattle population (CIBCP)) and potentially as development areas, 4 sub-districts have negative CIBCP values. The negative CIBCP value means that there is an overpopulation of beef cattle in terms of the availability of food crop waste as a source of feed, the region with development status of beef cattle in Majene Regency based on regional potential is categorized as follows, distribution area (DA) where Location Quotient (LQ) ≥ 1 and positive CIBCP namely Sendana, Tammerodo, Malunda and Ulumanda Districts. Areas with conditions like this are interpreted as beef cattle production centers and have relatively large population levels. This is in accordance with what was stated by Bonaudo (2013) which states that LQ ≥ 1 means that a region has a comparative advantage, where the population exceeds the needs in the area so that it can be sold outside the region. In addition, this region still has the ability to increase the population of cattle with the assumption that the carrying capacity of large areas is to develop beef cattle. The positive CIBCP value of food crop waste shows that the amount of feed from food crop waste is still quite widely available.The development area group (DAG) is the negative LQ <1 and CIBCP values, namely Banggae,

East Banggae and Pamboang Districts. This means that this region is not a base region and the amount of feed sourced from agricultural waste is also low, so that if an increase in beef cattle population needs to be added to alternative feed ingredients. This region is a base for developing beef cattle but with the condition that there is an effort to add alternative feed ingredients to meet the livestock's needs. This is in accordance with the opinion of (Cherdthong et al, 2011), that the plan to develop beef cattle population is inseparable from the carrying capacity of the region which includes two things, namely the availability of space for livestock and the availability of animal feed for their survival.

4. CONCLUSION

Based on the results of the inventory and mapping of carrying capacity of food crop wastes in Majene Regency, it results in areas that have the potential for the development of beef cattle which are divided into spread areas (DA), namely Sendana District, Tammerodo, Malunda and Ulumanda. Development area group (DAG), namely Banggae District, East Banggae, Pamboang and Tubo. It is expected that the establishment of beef cattle breeding business areas should be carried out in areas that have the potential in terms of region, livestock and feed carrying capacity in the form of food crop waste. Suggestions for the development of future beef cattle are to conduct research on the use of alternative feed ingredients from plantation waste and agro-industrial waste for beef cattle feed. Another thing that needs to be done is to carry out processing / preservation of food crop waste, where we know that the processing of food crop waste to be used as animal feed can increase the nutritional value of food and guarantee its availability on an ongoing basis throughout the year.

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