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The Carrying Capacity of Crop as Cow and Goat Feed in Muna Barat Regency

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ABSTRACT

This study aimed to assess the potency of forages in Muna Barat Regency as cattle and goat feed. The study was performed by performing forage observation based on the forage production multiplied by the harvested area, and presented on dry matter unit (DM). Sampling was carried out by using a designed square tool. Forages that was evaluated on this study was legume groups. Data analysis was performed by using carrying capacity method. The study reveals that there are 8 types of forages found in Muna Barat Regency. The dry matter of those forages can meet the feed requirement for cattle and goat in Muna Barat Regency. The result of KPRR analysis shows that Muna Barat Regency has carrying capacity for 2,669 cattle and 3,293 goat.

Keywords: Carrying capacity, Forages, Muna Barat

Introduction

Forages play important roles in supporting the life of either small or large ruminants. Moreover, the nutrient content of forages should be deliberately considered as the animal growth is affected by both quality and quantity of forages given to animal. Forages can be classified into 2 types, grasses and legumes. Ruminant requires large daily need of 60% of forages, either given in dried or fresh forms. Hence, it is common that farmers face difficulty to provide forages for their livestock due to the fact of land erosion and farmland conversion into building, affecting the forages production. Among other ruminants, the largest forage consumer is cattle and goat.

Muna Barat Regency is one of regencies located in Southeast Sulawesi, where cattle and goat are reared. The population of cattle in Muna Barat Regency reaches up to 21,654 heads, while the goat population is 5,390 heads (BPS, 2016). Those numbers are still considered smaller than livestock population in difference provinces in Southeast Sulawesi. The number of cattle population is hardly to improve because of the poor productivity of the animal itself (Noferdinan and Afzalani, 2013). Geographically speaking, Muna Barat Regency possesses a great potency for the farming development of cattle and goat as the regency holds numerous unused lands. Despite the land availability, the forage supply requires further assessment to ensure that it will meet the requirement. The main problem that hinders the cattle and goat farming development in Muna Barat is indeed the forage production. Prawiradiputra (2011) *cit.* Pomolango *et al*. (2016) reported that feed is a key factor that affects the growth of cattle and goat. Feed supply for cattle is a common problem faced by farmers (Alfian, 2012; Nugraha *et al*., 2013; Rahmansya *et al*., 2013; Salendu and Elly, 2013).

The farmers in Muna Barat Regency develop cattle and goat farms by utilizing several forages, such as field grass and legume. Unfortunately, the unavailability of information regarding the forage production in Muna Barat Regency becomes the main challenge of this development. Thus, this study was intended to evaluate the forage capacity to support the cattle and goat farming system in Muna Barat Regency.

Materials and Methods

Materials used in this study include the forage fields and forages for 21,654 cattle and 5,390 goat (data in 2016). Data source was primary and secondary data. Samples were collected from 3 villages in 11 municipalities in Muna Barat Regency, by considering the largest ruminant population (stratified random sampling). Respondents were those who are currently keeping ruminant animals. Interview was carried out by using a question list, directed to collect data regarding the feeding system and type of feed given to the animals. The forage potency is calculated based on the forage production multiplied by the harvested area, and presented as dry matter (DM) unit.

The forage production was obtained by sampling with a designed square plotting. Sampling was performed as these following procedures, a) sampling was performed systematically, b) The first sample area taken was decided randomly by throwing 1 m^2 of square plot, the second sample was taken from a plot with 10 m distance from the first sample area. These 2 sample areas made up a cluster. The second cluster was taken 20 meter from the first cluster, c) All forages in sample areas were recorded and their species were identified – ranked as I, II, and III class. If forages within the sample area was hard to estimate by observation, the forages in the 1 m^2 sample are were cut off accordingly as 5 to 10 cm above the soil surface, weighed, identified, and then the weight of each species was recorded. The number of sample areas was 99 areas and performed with 3 times of replication on each sample areas (Matulessy and Kastanja, 2013).

Data was subjected to descriptive analysis. The carrying capacity was also evaluated by calculating the carrying capacity of an area based on the feed source availability – using the Nell and Rollinson (1974) formulation as written as follow. (1) PML = a LS + b LK + c LPR + d LH + e LKb. In which, PML = optimal carrying capacity based on the feed source area, LS = ricefield/farmland, LK = dried land, LPR = grassland, LH = forest land, LKb = plantation land. (2) PMKK = d KK, in which PMKK = optimum potency based of farmer households, KK = number of farmer households, d = coefficient of the number of animal can be reared by each RTP. (3) PPT = PML – Pop. In which, PPT = potency of animal farming development, PML = optimum potency based on land, Pop = actual population. (3) PPTKK = PMKK – Pop. In which PPTKK = potency of animal farming development based on KK, PMKK = optimum potency. The forage calculation comprised: a) forages from natural resources: farmland, side of road, pasture land, forest land. Calculation was carried based on Direktorat Pakan Ditjennakkeswan. (4) KPPTR Analysis was calculated based on = carrying capacity based on dry matter production in one year per dry matter consumption per animal per day – actual animal population.

Result and Discussion

It is noticeable that there is reduction trend of population number of large and small ruminant animal. Cattle population in 2013 was 23,454 cattle. This number witnessed reduction to 21,654 cattle, and by 2016 it increased to 22,114. The goat population rose significantly. In 2013, goat population was 4,216 goat and reached 5,266; 5,390; and 6,474 goats in 2014, 2015, and 2016.

Information regarding animal population in sub-district levels are also necessary for planning the development of animal farming system. The population of large and small animals in Muna Barat Regency sorted by the sub-district is shown on Table 1.

Feed availability

Several forage types were observed in Muna Barat Regency. It comprised several grassed and legume that can serve as feed source, such as *Gliricidia sepium, Leucaena leucocephala, Centrosema pubescens, Natural or field grass, Pennisetum purpureum, Panicum maximum, king grass,* and *Brachiaria decumbens.* The varied feed consumption is supported by Hadi *et al.* (2011), animal feed can be obtained from forages that includes leaves of plant (including its stem and flower), and generally belong to graminae and legume groups. Forage production is an accumulation of annual yield per cultivated land area (Guslim, 2007). Plant production is affected by sun radiation and temperature. Reksohadiprodjo (1994) *cit*. Pomolango *et al*. (2016) stated that factors affecting dry matter content are plant species, growth phase, harvesting time, water, and soil fertility. Dry matter contents collected from plants in rainy season are relatively lower due to the fast growing rate, sufficient water availability, and less transpiration caused by high humidity. The result of forage analysis is shown on Table 2.

The Table 1 indicates that there were 9 types of forage used as animal feed in Muna Barat Regency. Those forages were obtained from field observation in all areas in the sub-district. All information regarding those forages were obtained by interviewing farmers about the feeding system they do. Forages comprised 2 types of legume

Table 1. Livestock population by sub-district in Muna Barat Regency in 2016

Sub-districts	Cattle	Goat
Barangka	1,275	318
Sawerigadi	3,018	429
Lawa	1,937	397
Wadaga	857	403
Kusambi	4,368	976
Napano Kusambi	1,833	260
Tiworo Kepulauan	833	1,226
Tiworo Tengah	4,494	353
Tiworo Selatan	1,250	210
Tiworo Utara	857	491
Maginti	914	327
Total	**21,654**	**5,390**

BPS, 2016.

Table 2. Forages composition in Muna Barat Regency

Forages	Nutrient content (%)	
	Dry Matter	Organic Matter
Gliricidia sepium	40.06	90.48
Leucaena leucocephala	31.85	91.72
Natural or field grass	29.05	92.51
Brachiaria decumbens	94.80	89.67
Pennisetum purpureum	93.47	92.99
Centrosema pubescens	94.85	93.99
Panicum maximum	93.60	93.51
king grass	91.78	94.63
Cyperus rotundus	95.86	93.39

Source: obtained from proximate analysis performed in Laboratory of Animal Feed and Nutrition, Faculty of Animal Science, University of Halu Oleo.

and 6 types of grass. Based on those collected data, forage production per area in each sub-district was examined to evaluate the forage production and carrying capacity of each area.

Forage production

The study revealed that harvesting area of forages that can be used as cattle and goat feed in Muna Barat Regency is fairly large (see Table 3). Table 3 shows the total of harvesting area for forages in Muna Barat Regency was 2,795.61 with 466.92 ha of average on each area. The largest harvesting area was obtained in Wadaga sub-district that contained 1,026.57 ha with the natural grass or field grass claimed 1,000 ha of total harvesting area. It was followed Tiworo Tengah sub-district and Lawa sub-district with their 542 ha and 421.83 ha of harvesting area. The least harvesting area was observed in Maginti sub-district that accounted for 39.3 ha of area. However, the forage production was considered fairly large (see Table 4).

The forage production in Muna Barat Regency was observed as fairly high. It can be

Table 3. Harvesting area of forage based on sub-district in Muna Barat Regency

Sub-District	(Forage production/year (tons))								
	Gliricidia sepium	*Leucaena leucocephala*	*Natural grass*	*Pennisetum purperum*	*Centrosema pubescens*	*Brachiaria decumbens*	*Panicum maximum*	*King grass*	*Total of harvesting area (ha)*
	Harvesting area (ha)	*Harvesting area (ha)*	*Harvesting area (ha)*	*Harvesting area (ha)*	*Harvesting area (ha)*	*Harvesting area (ha)*	*Harvesting area (ha)*	*Harvesting area (ha)*	
Kusambi	11.75	6.42	14	11.75	3.15	3.78	2.5	4.5	57.85
Napano Kusambi	6.75	3.75	170	6.43	1.15	1.24	3.75	1.75	194.82
Lawa	6.92	3.67	400	7.89	5.92	4.51	1.35	1.57	431.83
Barangka	5.25	1.05	164	10.66	7.57	7.35	1.75	1.65	199.28
Sawerigadi	10.88	2.47	13	14.45	6.76	5.34	1.25	6.87	61.02
Wadaga	3.2	1	1,000	5.06	5.62	8.21	2.25	1.23	1,026.57
Tiworo Tengah	7.25	7.25	500	12.55	3.56	2.31	4.75	4.33	542
Tiworo Selatan	6.25	6.25	15	9.57	4.15	2.25	2.15	2.35	47.97
Tikep	4	4	100	5.44	3.67	3.11	3.88	3.05	127.15
Tiworo Utara	3.25	1.36	50	8.35	4.05	5.57	4.87	2.12	79.57
Maginti	1.75	1	25	5.35	2.25	1.75	1.15	1.05	39.3
Total	**67.25**	**38.22**	**2,451**	**85.75**	**47.85**	**45.42**	**29.65**	**30.47**	**2,795.61**
Average	**6.11**	**3.47**	**222.82**	**8.86**	**4.62**	**4.13**	**2.7**	**2.77**	**466.92**

Table 4. Total of forage production in Muna Barat Regency

Sub-district	*Gliricidia sepium*	*Leucaena leucocephala*	*Centrosema pubescens*	Grass					Total of forage production (tons/year)
				Natural or field	*Pennisetum purpureum*	*Panicum maximum*	King	*Brachiaria decumbens*	
	Dry matter/year (tons/year)	Dry matter/year (tons/year)	Dry matter/year (tons/year)	Dry matter/year (tons/year)	Dry matter/year (tons/year)	Dry matter/year (tons/year)	Dry matter/year (tons/year)	Dry matter/year (tons/year)	
,Kusambi Napano	**14.11**	**0.45**	89.63	1.79	2,196.55	234	826	342.22	3,704.75
Kusambi	8.11	0.26	32.72	21.71	1,202.02	351	321.2	112.26	2,049.28
Lawa	8.31	0.26	168.45	51.08	1,474.96	126.4	288.2	408.31	2,525.97
Barangka	6.31	0.07	215.4	20.94	1,992.78	163.8	302.9	665.42	3,367.62
Sawerigadi	13.07	0.17	192.36	1.66	2,701.28	117	1,261.1	483.45	4,770.09
Wadaga	3.84	0.07	159.92	127.7	945.92	210.6	225.8	743.28	2,417.13
Tiworo Tengah	8.71	0.51	101.3	63.85	2,346.1	444.6	794.8	209.13	3,969
Tiworo Selatan	7.51	0.44	118.09	1.92	1,789.02	201.24	431.4	203.7	2,753.32
Tikep	4.81	0.28	104.43	12.77	1,016.95	363.17	559.9	281.56	2,343.87
Tiworo Utara	3.9	0.1	115.24	6.39	1,560.95	455.83	389.1	504.27	3,035.78
Maginti	2.1	0.07	64.02	3.19	1,000.13	107.6	192.7	158.43	1,528.24
Total	**80.79**	**2.69**	**1,361.57**	**313**	**18,226.6**	**2,775.24**	**5,593.1**	**4,112.05**	**32,465.09**
Average	**7.34**	**0.24**	**131.54**	**28.45**	**1,656.97**	**252.29**	**508.5**	**373.82**	**2,959.16**

seen form the total forage production that reached 32,465.09 tons of dry matter/year, with 2,959.16 tons/year of average production in each sub-district. The highest production was seen in Sawegadi sub-district with its 4,770.09 tons/year of yield, while 1,528.24 tons/year of lowest production was seen in Maginti sub-district. *Pennisetum purpureum* had the highest production, yielding 18,226.6 tons/year of dry matter. Conversely, signal grass produced 4,112.05 tons of dry matter/year, while the lowest production is noticed in *Leucaena leucocephala* with its 2.69 tons dry matter/year.

Carrying capacity (cattle)

Carrying capacity was determined based on method proposed by Nell and Rollinson (1994) which is a comparative method – limiting the forages sources. Carrying capacity is the ability of an area to hold either large or small livestock based on the number of forage production. Carrying capacity can be also referred as the ability of pasture land to produce a number of forages that required by livestock grazed in the area within one hectare of area (Reksohadiprodjo, 1994 *cit.* Pomolango *et al*., 2016). The calculation of carrying capacity was performed based on the assumption that livestock consume forages as much as 3 to 4% of their body weight. Feeding was carried out accordingly to follow that assumption by providing 3 to 4% dry matter based on the live weight and the forages availability in each sub-district.

Feedstuff can be in dried or liquid form. Feed is provide to livestock to support both their live and production requirement. The field observation shows that the body weight of large and small animals in Muna Barat Regency varied, thus for analysis purpose, the average body weight on each area were used for analysis. The body weight of large and small livestock in Muna Barat Regency is presented on Table 5.

The data shows that the bodyweight of Bali cattle in Muna Bara Regency has undergone reduction – an opposite finding compared to Talib (2002) *cit.* Prasojo *et al*. (2010) that reported new calf weight, weaning, young, and mature cattle weight were 11.4 to 21.5 kg, 64.4 kg, 129 kg, and 303 kg respectively. Finding on this study might be a result of traditional rearing system and the possibility of in breeding among the livestock. In breeding can lead to poor genetic quality.

Dry matter requirement of calf is 1.65 kg/head/day (602.25 kg/head/year), while young and cattle cattle require 3.6 kg/head/day (1,314 kg/head/year) and 7.5 kg/head/day (2,737.5 kg/head/year) of dry matter. For goat, a kid requires 0.15 kg/head/day (54.75 kg/head/year) of dry matter, while young and mature goat need 0.48 kg/head/day (175.2 kg/head/year) and 0.81 kg/head/day (295.65 kg/head/day).

Carrying capacity for cattle (KPPTR) in Muna Barat Regency was calculated based on the formulation in which the total carrying capacity is reduced by the actual cattle population in Muna Barat Regency. Meanwhile, the carrying capacity was calculated based on the result of forage analysis (dry matter based) compared to the dry matter requirement in one year (365 days). The carrying capacity data is shown on Table 6.

According to KTT analysis of forage production, Muna Barat regency holds great potency. Muna Barat regency produces as many as 32,465 ton/year of forages (dry matter basis) and can meet the requirements of calf, young cattle, and cattle as many as 54,108; 24,782; and 11,849 heads. Compared to other sub-districts, Sawerigadi has the highest carrying capacity (7,950 calf or 3.641 young cattle or 1,741 cattle). Meanwhile the lowest carrying capacity was observed in Maginti sub-district (2,547 calf or 1,167 of young cattle or 558 cattle).

KPPTR of cattle and goat was calculated by subtracting carrying capacitiy (KTT) based with

Table 5. Avarage of bodyweight of livestock in Muna Barat Regency

Weight and DM requirement/head/day	Livestock	
	Cattle	Goat
Calf	55	5
(kg/DM/head/day)	1.65	0.15
Young	120	16
(kg/DM/head/day)	3.6	0.48
Mature	250	27
(kg/DM/head/day)	7.6	0.81

Table 6. Carrying capacity of Muna Barat Regency based on forage production (cattle)

Sub-district	Total of harvesting area	Total of forage production (tons/year)	Calf	Young	Mature
Kusambi	57.85	3,704.75	6,175	2,828	1,352
Napano Kusambi	194.82	2,049.28	3,415	1,564	748
Lawa	431.83	2,525.97	4,210	1,928	923
Barangka	199.28	3,367.62	5,613	2,571	1,229
Sawerigadi	61.02	4,770.09	7,950	3,641	1,741
Wadaga	1,026.57	2,417.13	4,029	1,845	882
Tiworo Tengah	542	3,969	6,615	3,030	1,448
Tiworo Selatan	47.97	2,753.32	4,589	2,102	1,005
Tikep	127.15	2,343.87	3,906	1,789	855
Tiworo Utara	79.57	3,035.78	5,060	2,317	1,108
Maginti	39.3	1,528.24	2,547	1,167	558
Total	2,795.61	32,465.09	54,108	24,782	11,849

actual cattle and goat population in Muna Barat regency. Generally, the livestock population number provided by Central Bureau of Statistics of Muna Barat regency are not presented in without differentiating it based on the age category, such as calf, young cattle, and cattle. Thus, the population was assumed to be young cattle. The assumption was supported by the consideration of existing condition and field observation in Muna Barat regency in which the majority of population observed in the regency was young cattle. The result of KPPTR analysis is shown on Table 7.

Based on the forage production, Muna Barat regency has carrying capacity for 24,783 cattle. Compared to cattle population in 2017 (22,114 cattle), the carrying capacity could carry more 2,669 cattle. This condition indicated that under-grazing in Muna Barat regency where the forages produced was higher than the cattle population, though some sub-districts witnessed over-grazing condition. The carrying capacity for cattle of Kusambi, Napano Kuwambi, Lawa, and Tiworo Tengah Sub-districts were -1,540, -269, -9, and -1,464 respectively. Negative value of carrying capacity demonstrated the over-grazing condition of the areas. The forage production in those sub-districts could not meet the feed requirement of cattle. However, other 7 sub-districts showed positive carrying capacity value which means the forage production in those areas could supply the feed requirement of cattle population. The carrying capacity for cattle of Barangka, Sawerigadi, Wadaga, Tiworo Selatan, TIkep, Tiworo Utara, and Magindi subdistricts were 1,296, 555,988, 664, 802, 1,460, and 185 respectively. The curve of carrying capacity for cattle in severel sub-districts in Muna Barat Regency is shown on Figure 1.

Carrying capacity (goat)

The carrying capacity analysis (KTT) for goat was calculated based on forage production in dry matter basis which was compared to the feed consumption of goat (dry matter basis) in 365 days. The carrying capacity analysis for goat is shown on Table 8.

According to the KTT analysis that had been carried out in this study, the forage production in Muna Barat regency show fairly big potency. The total forage production for goat in Muna Barat regency reached 1,758.05 tons/year and could supply feed for 35,161 lamb or 9,767

Table 7. Ruminant carrying capacity analysis (cattle)

Sub-District	*Carrying capacity*	Population	Ruminant Carrying Capacity (KPPTR)
Kusambi	2,828	4,368	-1,540
Napano Kusambi	1,564	1,833	-269
Lawa	1,928	1,937	-9
Barangka	2,571	1,275	1,296
Sawerigadi	3,641	3,086	555
Wadaga	1,845	857	988
Tiworo Tengah	3,030	4,494	-1,464
Tiworo Selatan	2,102	1,438	664
Tikep	1,789	987	802
Tiworo Utara	2,317	857	1,460
Maginti	1,167	982	185
Total	**24,783**	**22,114**	**2,669**

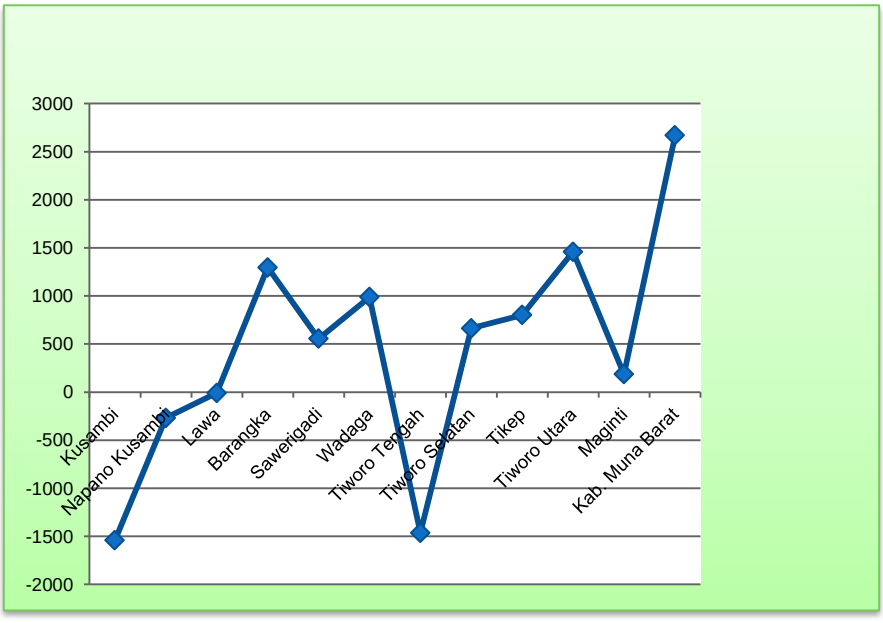

Figure 1.The curve of carrying capacity of cattle in Muna Barat Regency.

Table 8. Carrying capacity of Muna Barat Regency based on forage production (goat)

Sub-districts	Harvesting area (ha)	Average of total production (tons/year)	Goats		
			Lamb	Young	Mature
Kusambi	35.32	105.98	2,120	589	353
Napano Kusambi	181.65	62.8	1,256	349	209
Lawa	416.51	228.1	4,562	1,267	760
Barangka	177.87	242.72	4,854	1,348	809
Sawerigadi	33.11	207.26	4,145	1,151	691
Wadaga	1,009.82	291.53	5,831	1,620	972
Tiworo Tengah	518.06	174.37	3,487	969	581
Tiworo Selatan	31.65	127.96	2,559	711	427
Tikep	111.67	122.29	2,446	679	408
Tiworo Utara	58.66	125.63	2,513	698	419
Maginti	30	69.38	1,388	385	231
Total	**2,604.32**	**1,758.05**	**35,161**	**9,767**	**5,860**

Source: Analyzed data (2007).

lamb or 5,860 mature goat. After getting the KTT value, KPPTR was analyzed by comparing the KTT value with the number of goat populationin Muna Barat regency. The goat population was assumed in the way that similar with the KTT analysis for cattle as the data used were not grouped based on the livestock structure (age). The KPPTR value for goat in Muna Barat regency is presented on Table 9.

The analysis shows that Muna Barat regency could accommodate as many as 9,767 goats, while the 2017's goat population in Muna Marat was 6,474. Thus, the KPPTR value for goat in Muna Barat regency was 3,293 goats. This value indicated the under-grazing condition in which carrying capacity was much larger than the goat population. However, some sub-districts experienced over-grazing condition.

There were 4 sub-districts whose negative KPPTR value: Kusambi, Tiworo Tengah, tikep, and Maginti (-387, -257, -748, and -34 respectively) – indicating the over-grazing condition. Conversely, other 7 sub-districts had positive KPPTR value: Napano Kusambi, Lawa, barangka, Wadaga, Sawerigadi, Tiworo Selatan, and Tiworo Utara – indicating the under-grazing

Table 9. Ruminant carrying capacity (goat)

Sub-districts	Carrying capacity	Population	KPPTR (*Ruminant carrying capacity*)
Kusambi	589	976	-387
Napano Kusambi	349	260	89
Lawa	1,267	397	870
Barangka	1,348	318	1,030
Sawerigadi	1,151	447	704
Wadaga	1,620	260	1,360
Tiworo Tengah	969	1,226	-257
Tiworo Selatan	711	253	458
Tikep	679	1,427	-748
Tiworo Utara	698	491	207
Maginti	385	419	-34
Total	**9,767**	**6,474**	**3,293**

Source: Analyzed data (2017).

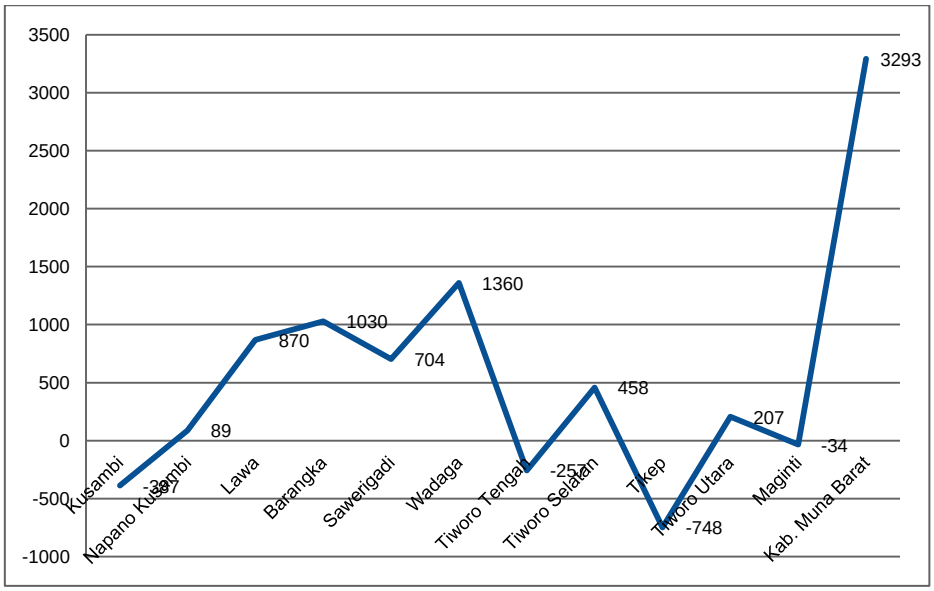

Figure 2. Carrying capacity of goat.

condition that means the forage production excessed the feed requirement of available goat population in those areas. Along with the Sindaon (2013) study, the dry matter availability form all identified feed sources were 12,253,787,849 tons – producing KKTR value as many as 5,237,513,687 ST that indicated the high carrying capacity. The trend of goat carrying capacity of Muna Barat regency is presented on Figure 2.

Conclusions

Forage production in Muna Barat Regency consisted of *Gliricidia sepium, Leucaena leucocephala, Centrosema pubescens, Natural or field grass, Pennisetum purpureum, Panicum maximum, king grass,* and *Brachiaria decumbens*. Generally, the dry matter production in Muna Barat regency could supply feed requirement of cattle and goat. Carrying capacity of sampling area in Muna Barat regency was 24,783 cattle and 9,767 goat. KPPTR analysis compared the carrying capacity with the actual animal population (22,114 cattle and 6,474 goat) demonstrated that Muna Barat regency could accommodate more animal (2,669 cattle and 3,293 goat).

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