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Cattle Farm Development by Forages Cultivation on Coconut Land Based on Carrying Capacity in West Bolangitang, Indonesia

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Abstract— West Bolangitang became one of the central areas of livestock development in North Sulawesi, Indonesia. Livestock are usually only kept and grazed under coconut trees, and consumes waste from food crops and even grass that grows wild under coconut trees. The research analyzed the potential of cattle development based on carrying capacity index of forages on coconut land. This research has been conducted using survey method, and data source is primary data. The sample villages were determined by purposive sampling, with 32 respondents. The research material is coconut land and cattle. Analysis of data used is the analysis of the carrying capacity index (IDD). The results showed that the District of West Bolangitang has a coconut land, 3,668 Ha, with a real population of 2,044 AU. PMSL value of 4,744.24, meaning that based on land resources in this district can still accommodate the population of cattle for the value of PMSL. Total feed requirement amounted to 2,330.16 tons with a value of the carrying capacity of 2.04. Based on result of the research, it can be concluded that population of cattle in West Bolangitang District can still be improved by utilizing the land under coconut tree. Suggestion is need introduction of superior forage in supporting the development of cattle farms.

Keywords— Carrying capacity, cattle, coconut.

I. INTRODUCTION

Coconut plants are dominant plants in some areas in Indonesia including North Sulawesi. Coconut plant is one of plantation plants that are able to adapt to the environment, growing in tropics and can be found both in lowlands and highlands. The coconut plant grows and produces well at an altitude of 0-450 meters from sea level, and grow well in coastal areas [1,2].

The coconut plant in this area is a deep coconut that can reach age of 100 years. Coconut starts to produce rather slowly that is 6-8 years after planting^[1]. Coconut is known as a plantation commodity, which is export orientation. Coconut farming is a source of income for some people of West Bolangitang District which are sold in the form of

copra. These commodities contribute to farmers' income, as well as the potential employment for agricultural sector growth.

West Bolangitang is one of the central areas of livestock development in North Sulawesi, Indonesia. The cattle developed in this region has potential as a reliable business as a source of income. Cattle can be sold at any time by farmers to meet the needs of family members. In this case cattle farming can provide economic value added for farmers, in rural areas. Cattle in addition to providing a role as a source of income, also plays a role in opening employment opportunities and as a source of animal protein. Cattle product as a reliable commodity in order to meet the demand for beef tends to increase. This can support government programs in meeting the needs of animal protein, whose goal is to improve the nation's intelligence.

The resources of cattle are potential economic commodities to be developed and can be used as a prime commodity because it has the potential to increase economic growth in the research area. Cattle farming, in this case has a strategic role in the life of the economy and the development of Indonesian human resources. The role as described has been seen from the function of cattle products as a provider of animal protein which is essential for the growth and development of the human body. The increasing trend of consumption of food produced by cattle is a challenge as well as opportunities for livestock sub-sector to increase the production of cattle efficiently and competitively.

The priority of cattle development programs in the study areas is still an increase in population. The population increase program is conducted through the introduction of cattle by the government. The fact at the site of the study shows that the source of cattle in this area is still relied on traditional farms, the management of the sideline and simple. In general, the cattle farming is still relies on natural grass that grows freely in the field for agriculture or coconut plantation. The characteristics of traditional livestock farming, among others, the number of cattle

ownership of 1 to 3 heads per family, limited land area, cattle rearing is done alone and simple relatively and waste management is produced relatively low. The characteristics of traditional livestock farming systems are cattle ownership of 1 to 3 heads per family, limited land area, cow maintenance carried out by farmers and members of their families and relatively simple, and the management of cattle waste produced is relatively low. Development of traditional cattle has been done by utilizing agricultural waste, but still done partially with diversification system^[3]. West Bolangitang District is one of the districts in North Bolaang Mongondow Regency that develop cattle. Cattle are grazed in the land under coconut trees. The area under the coconut tree is a dry potential for development of cattle^[4]. Cattle consume food crops and grass that grows wild under coconut trees. Coconut land cultivated many crops, especially maize and used as cattle grazing land, especially cattle^[5]. Based on existing conditions, the management of cattle raise as one of the keys to livestock succeed, should no longer be traditional oriented.

The main constraint faced by farmers in the development of cattle is unavailability of adequate and continuous forages, especially in dry season. These constraints that cause some farmers are forced to sell cattle at a relatively cheaper price. Feed is one of the factors that determine the success of the livestock business. Furthermore, related to the increase in population and productivity of cattle, the factors that need attention are feed both of quantity and quality, price and availability.

The increase of cattle population in some areas including in the research area, still oriented to the ability of a region in providing cattle feed (carrying capacity). However, the area of feed source, whether in the form of common pasture from cattle or forage specific fields, shows tend to decrease. The constraints that often found in beef cattle farming is the low productivity of beef cattle because of the quality of feed that does not meet the nutritional needs of livestock^[6].

Farmers generally only cultivate forage crops in the lands, fields and on the edge of the irrigation canal. Cultivation of forage grasses of fodder will be more effective with livestock integration systems with^[7]. The land under coconut trees can be utilized for quality forage development. This is because forage feed is the main feed ingredient for the life of cattle.

Forage development under coconut trees should be done for the life and growth of cattle. Provision of feed throughout the year is an important factor that must be considered in supporting the population and productivity of cattle. The provision of feed is not only quantity but also must pay attention to the quality of feed. Increasing the quality of the feed is intended so that the needs of

cattle food substances can be met and achieved and sustainable. Cattle require food substances with aim that the preservation of life and wholeness of components of the livestock body (basic necessities of life) and the purpose of production (production needs) can be maintained.

Forage feed is basically, as a decisive factor in the development of cattle farms. Forage plays an important role because it contains many nutrients needed for cattle as a source of energy in the activity, growth and benefits for cattle who are breastfeeding. Forage is a source of fiber, even forage in the form of leguminous, into mineral supplementation, and cheap protein for cattle.

The problem is how far the potential development of cattle under coconut tree. The potential of development of cattle is associated with the carrying capacity of feed under coconut trees. This is because feed is one of important factors in increasing the productivity of cattle. The available feed, in addition to quality, should also be available throughout the year, and economically, in order to benefit farmers. Successful development of cattle is determined by the availability of forage in sufficient quantities, and can be sustainable. Based on these problems, we have conducted a study with the aim of analyzing potential of cattle development based on index of carrying capacity of feed in coconut land.

II. MATERIALS AND METHODS

The subject of this research is cattle farmers in West Bolangitang District of North Bolaang Mongondow Regency. Cattle are farmers' livestock in West Bolangitang District. Coconut land is unused land for forage feed. The research method is survey method with data source is primary data. The sample villages were determined by purposive sampling, with 32 respondents. The data analysis used is ICC analysis^[8], such as equation (1).

$$ICC = \frac{PMSL}{TK} \dots\dots\dots (1)$$

Description :

ICC = Index of Carrying Capacity

TK = Total feed requirements

TK = k x POPRIL

k = The constant requirement of dried material is digested (DDM) by one animal unit that is: 1.14

III. RESULTS AND DISCUSSION

Potential of livestock development is effectively analyzed using analysis of the maximum potential of land resources (PMSL), as in Table 1.

Table.1: Results from PMSL Analysis

No	Coeffisient/Variable	Value of Variable
1	A	0,80
2	LG	3.668,00
3	B	0,50
4	PR	3.504,48
5	C	1,20
6	R	48,00
PMSL		4.744,24

Description :

PMSL = Maximum potential in animal unit of cattle (AU based on land resources .

A = The coefficient calculated based on ratio of ruminant livestock population in animal unit (AU) to cultivated land area (Ha), referenced from East Java provincial standard, 1995 was 0.8 AU / Ha.

LG = Area of coconut at research location (Ha)

B = The coefficient is calculated as carrying capacity of natural grasslands (1995 = 0,5 AU/Ha)

PR = Area of grassland (Ha)

C = The coefficient is calculated as carrying capacity to swamp (1,2 AU/Ha)

R = Area of swamp (Ha)

The results of Carrying Capacity Index analysis can be seen in Table 2

Table.2: Index of Carrying Capacity of Forages

No	Coeffisient/Variable	Value of Variable
1	PMSL	4.744,24
2	K	1,14
3	POPRIIL	2.044,00
4	TK (kxPOPRIIL)	2.330,16
ICC		2,04

Description :

POPRIIL = The real population of cattle (AU) in the study area

ICC = Index of carrying capacity

TK = Total requirement of feed (TK = k x POPRIIL)

K = The constant requirement of dry matter (DM) by one animal unit is: 1.14

The success of cattle farming can not be separated from the role of government, private sector and society in this case cattle farmers. The success also requires the support and utilization of technology so as to ensure the increase in population, productivity and sustainability of cattle farming. Age as characteristics of farmer affect absorption of technology and success of cattle farming in the District

of West Bolangitang. Age of respondents is mostly included in the productive age, which ranges from 21 to 60 years (93.75 percent or 30 respondents). The lowest education level of respondents is the elementary level (65.62%), followed by the junior secondary (21.88%), senior high school (6.25%) and the highest level of PT (6.25%). Based on research results, the level of education of farmers is mostly categorized low farmers that have an impact on the success of cattle farming, where education is important for the agricultural sector that is not yet modern and the application of technology is low¹⁹.

Cattle is one component of food fulfillment, plays an important role in relation as a source of animal protein from livestock. The collaboration of various world food institutions to make livestock as an important commodity is seen from the missions launched "livestock to 2020, the next food revolution"¹⁰. The importance of the development of cattle is in support of food security, so that these animals can be developed with sustainable and environmentally friendly. Cattle development, which is environmentally friendly and based on local resources, is a strategic step in realizing the improvement of the quality and quantity of livestock products¹¹.

Dry land in the research area has great potential for agricultural development, both food crops and annual crops or plantations (more specifically coconut plants). The development of agricultural commodities in dry land is one of the strategic choices in increasing production and supporting national food security. Type of dry land shows lower productivity, for it requires optimal handling, and sustainable, in the face of dry land issues¹⁸. The biophysical problems faced by dryland farmers are the destruction of land function as a growing medium, such as soil sensitivity to erosion, minimal nutrients, and limited organic matter content¹⁸. Land degradation is a problem faced by various countries¹². Management of agro-ecosystem from coconut and cattle in the research area is done by utilizing the land under coconut for the development of cattle.

The results showed that, the farmers manage coconut plant, on average 1.31 Ha, for 32 respondents as many as 92 heads, the amount of each farmer ownership of about 2-7 cattle. The ownership of cattle according to the results of the study showed that farming cattle managed by farmers, is still a sideline business. In fact, cattle farms in Indonesia, for the most part, are still dominated by small-scale peasant farms, located in rural environments. The technology used is also still simple or traditional. The existing livestock ownership is still as a savings, and as one indicator of the social status of the farmer. The development of cow farming by farmers is now more concerned with livestock productivity, meaning that they

have not considered the environmental aspects or the impact of their livestock activities on the environment.

The cattle belonging to the respondents according to the results of the study were grazed under coconut trees, with food consumed being waste from food crops and wild grasses. This causes productivity of cattle is lower than cattle in other areas. Whereas, is one of factors that determine both the bad growth of cattle^[13]. The productivity of cattle is largely determined by quality of feed consumed. The quality of feed includes understanding the content of various nutrients such as energy, protein, minerals, vitamins and the content of anti-nutritional substances such as tannins, lignin, and other secondary compounds. Feed is the main obstacle faced by farmers^[8,14]. The forages commonly used as feed for smallholder livestock are field grasses and agricultural by-products as well as some introduced grasses^[15]. Low productivity of cattle is due to the feed consumed in low quantity and quality^[3]. In addition, about 62 percent of farmers said the provision of forage feed is a limiting factor of cattle farming^[16]. Efforts to increase the productivity of cattle to meet the nutritional adequacy standards of community need to be done in several ways, such as by optimizing the utilization of local feed resources under coconut trees, and agroindustry through a system of crop-livestock integration. Another way to do this is to develop a system of cattle farming sustainable, integrated, and environmentally friendly, that can improve farmers' welfare. The carrying capacity of land under the coconut trees can be determined by firstly analyzing the potential for effective livestock development.

The data in Table 1 shows that maximum potential value of land resources, under coconut trees is 4,744.24 AU, meaning that based on the land resources in this area can still accommodate cattle for value of the PMSL. This phenomenon indicates that increase of cattle population in this area needs to be encouraged so that available resources can be utilized optimally. This effort can be done in order to optimize land under coconut, because utilization of land resources in support of agricultural development in future still continues and improved. The goal is to balance the increase in population and food needs. Strategy and effort of land resource utilization can be done by optimizing the utilization of existing land resources to be more productive and sustainable^[17]. The results of this study can be used as recommendations for government in an effort to increase growth of cattle. The one of information availability of feed is needed to accelerate the development of cattle farms^[18]. Higher cattle population indicates one of potentials and opportunities that can be utilized to provide added value in cattle business. Increasing population of cattle in this case can affect increase in farmers' income. Furthermore, the

increase in number of cattle has an impact on improving social status of farmers^[19]. Increasing the population of cattle also has an impact on increase of family nutrition consumption in this case the product of cattle is a source of animal protein. The demand for meat shows a significant increase, for last few years, so it is a good market opportunity for cattle.

The value of Carrying Capacity Index of 2.04 (Table 2) indicates carrying capacity of the land is quite high, meaning that maximum potential of land resources is still greater than need for feed. Based on the land potential, the real population can still be increased up to 2.04 times. The results of analysis are based on potential of effective coconut land. The indication of carrying capacity of feed is greater than population of beef cattle in District of West Bolangitang. The capacity of ruminant according to results of his research is greater than livestock population due to rainy season forage production is available in large quantities^[20]. Sustainable forage production is an important factor in cattle production systems. The strategy to achieve success of beef cattle farming, one of which is need for technology intake^[21]. Forage feed needed by cattle can be given directly in fresh or processed. That is, farmers should be more innovative in feeding forage for cattle, to anticipate if there is a dry season because forage feed more difficult to obtain. Farmers need knowledge of how to store forages in fresh form, until a certain period of time.

Land under coconut trees according to research results, not yet exploited, utilization of plantation land has not been maximized^[22]. Land under coconut trees in West Bolangitang District can be used for forage development. Availability of forage land will determine amount of forage feed^[23]. Land under coconut trees in the research area, in this case can be utilized for forage development. Utilization of land under coconut trees for forage feed can serve as cover crops^[8]. This can be done for the purpose of land closure, so that there is no erosion and can increase soil fertility. Utilization of land under coconut trees in support of development of cattle is an effort in supporting agricultural business in an integrated manner. Integrated farming is better known as integrated farming system as recommended by some researchers. The research related to the integrated farming system whose purpose is to explain the natural resources without any negative impact to environment^[24]. The research that integrated farm management is less risky, if managed efficiently can provide benefits and produce environmental health^[25]. In relation to the increasingly limited agricultural land, suggested farming system is an integrated farming system. The integrated farming system, is right choice because of the limited ability of agricultural resources^[26]. The integrated farming system according is an alternative effort in order to improve the efficiency of cattle business in

farmland^[27]. Furthermore, the integrated farming system is an alternative to climate change mitigation^[28]. Integration of livestock and crops is often recommended as one of the most promoted solutions related to occurrence of soil fertility decline and a loss in intensification system productivity^[29]. Integrated farming system approach as an effort made by pressing production cost, especially on the provision of land for forage, cattle as a source of labor, and can contribute in suppressing the purchase of fertilizer. Optimal benefits in integrated farming system can be achieved if it meets the criteria of agricultural development that can combine economic interests, socio-cultural and environmental sustainability. This system of integration is increasingly important given the availability of dry land for development of livestock and feed source is increasingly limited and expensive.

Introduction of superior forage is needed in supporting development of cattle farm agribusiness. Cattle farming agribusiness is a priority of the government in an effort to increase population and productivity of cattle. The development of cattle farming by rural farmers is expected to be done with agribusiness orientation. Steps that can be pursued among others, by involving aspects of commodities in system of agribusiness and agroindustry^[30]. The development can be done through the application of Good Farming Practice with special attention to aspects of cattle breed ownership and strengthening of feed in increasing productivity of beef cattle^[31]. Essentially feed is the basis in development of cattle farms.

The development of cattle population in the future will face the challenge of availability of forage feed, where the more cattle population increase, so the demand for feed forage will increase as well. Integrated development of cattle farms with coconut crops, intended in addition to efficient land use, also primarily to implement environmentally sound farming systems.

IV. CONCLUSION

Based on result of the research, it can be concluded that population of cattle in West Bolangitang District can still be improved by utilizing the land under coconut tree for a program to increase forage feed for cattle production development with integrated coconut plant. Suggestion is need introduction of superior forage in supporting the development of cattle farms

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