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RESEARCH ARTICLE

THE OPTIMIZATION OF BEEF CATTLE BUSINESS WITH CROPS IN THE HIGHLANDS IN BOLAANG, NORTH MONGONDOW REGENCY.

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Abstract

The application of integrated farming systems for the integration of livestock and crops has proven to be very effective and efficient in the context of community food supply. Research aims to analyse the optimization of integrated farming systems in the highlands. This research was carried out in July to September 2018 in Sidodadi Village, Sangkub District, Bolaang, North Mongondow Regency, North Sulawesi Province. The study uses survey methods and direct interviews with respondents. To answer the research objectives, linear programming analysis is used using Linear Program Solver (LiPS) and Microsoft Excel software. The results showed that 1) Factors that greatly influenced the increase in farm income were land area, business capital and labour. 2) Analysis of the type of business in the highlands which is obtained optimal income is the income generated in the optimization of the cattle-rice business shows the results of net income of farmers in the lowlands of Rp. 42,787,417 per year, so this farm is very optimal and feasible to work on. 3) The results of the optimization of the cattle-corn-coconut business get the lowest income of Rp. 25,507,057 per year so that this farming is not optimal to be developed.

Introduction:-

Integrated farming system between livestock and crops has become one of the government programs in the development of environmentally friendly animal husbandry programs. Sujana (2009) explained that the integrated animal husbandry system, which is an integrated system of cattle and crops, has now become a national priority to create a friendly agricultural environment.

The livestock subsector has a strategic role in economic life and human resource development. The role can be seen from the function of livestock products as a provider of animal protein that is important for the growth and development of the human body. The development of the livestock subsector is inseparable from agricultural development in general. This is because the livestock sub-sector can interact with other sub-sectors, especially in the crop sub-sector. Livestock subsector can be used as a source of organic fertilizer and agricultural waste can be used as a source of feed. Animal Husbandry (Budinuryanto, 2010) is defined as all matters relating to physical resources, seeds, seeds and or going to, feed, tools and machinery for farmers, cattle farming, harvesting, postharvest,

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marketing processing and processing. Hartono (2011) explains that the income derived from livestock business between breeding patterns and fattening patterns on a small scale there is no moderate difference.

Cattle have a very big role in the crop farming system in dry land, especially in producing manure which can be used as a source of organic material. Muis (2015), explains that one adult cow can produce 12-15 kg/day of solid waste and 3-5 liters of urine/day. The potential of manure production is very supportive of both the farming system and farms.

Cattle business has the potential to be developed as a profitable business. Cattle are one of the largest meat-producing livestock commodities from the ruminant livestock group to the national meat production (Suryana, 2009). One of the problems faced by traditional cattle ranchers is low cattle productivity. Cattle maintenance with traditional systems causes the lack of role of farmers in managing their breeding. The role of ruminants in farming communities is not a major commodity (Haryanto, 2009). Indonesian people do not need to worry about the statement that the main cause of global warming is caused by agricultural waste such as rice straw which is often burned after harvesting, but rice straw can be used as ruminant animal feed, because it can be overcome by building an integrated farming system (Chuzaemi, 2009).

The problem is that the integration system in Bolaang, North Mongondow Regency has not been implemented as the concept of integration is often recommended by researchers and the government. Integrated farming systems are the best farming systems in terms of resources, efficiency, productivity, production and food supply (Ahmed et al, 2011). Under these conditions it is necessary to study the results of previous research on the integration of cattle and crops.

Research purposes:-

The purpose of this study is to analyze the optimization of integrated plateau farming systems.

Research Methods:-

Location and Time of Research:-

This research was conducted in Sidodadi Village, Sangkub Subdistrict, Bolaang, North Mongondow Regency, North Celebes Province for three months, from July to September 2018. The overall selection of research sites was using multistage sampling method, but each level of the research location was carried out by purposive sampling.

Sidodadi Village, Sangkub Subdistrict was chosen as the research location because based on Bolaang, North Mongondow District Regulation No. 3 of 2013 concerning Spatial Planning for North Bolaang Mongondow Regency in 2013 - 2033 in Sangkub Subdistrict is an agricultural and livestock area, has a farmers who already implemented an effort to integrate beef cattle with crops, is the largest sub-district of corn crops, some corn crops are planted under coconut trees.

Sidodadi village located in the highlands has the widest area of corn crop in Sangkub District which is 325 ha, and the number of farmers 142 people some of the corn croped under coconut trees and has used livestock manure as compost on corn and coconut trees and corn waste is used as animal feed, BPP Sangkub District (Anonymous, 2016).

Table 1:-Number of Cattle in North Bolaang, Mongondow Regency by District

No.	District	Cattle Population (Tail)	Livestock Unit Populations (ST)
1.	Sangkub	3.265	2.332,14
2.	Bintauna	2.290	1.635,71
3.	East Bolangitang	2.435	1.739,29
4.	West Bolangitang	2.643	1.887,86
5.	Kaidipang	2.884	2.060,00
6.	Pinogaluman	2.870	2.050,00
Total		16.387	11.705,00

Source: Bolaang, North Mongondow District Agriculture Office (2016)

Table 1 show that the highest cattle population is in Sangkub District with a total of 2,332.14 ST, while the lowest cow population is in Bintauna District.

The sample location in this study was determined by purposive sampling is a district that has the largest cattle population and there is the largest corn land in North Bolaang Mongondow Regency. Commodity of rice and corn rice based on area can be seen in Table 2.

Table 2:-Rice, Corn and Coconut Commodity of Area in North Bolaang Mongondow Regency in 2016

No	District		Area of Commodity (ha)			Note
		Field rice	Corn	Soybean bean	Coconut	
1	Sangkub	1.621,48	2.220,00	100,00	1.078,60	
2	Bintauna	1.356,56	1.722,00	50,00	2.230,70	
3	East Bolangitang	388,58	1.995,00	25,00	3.481,67	
4	West Bolangitang	798,40	660,00	35,00	3.614,62	
5	Kaidipang	619,00	1.131,00	25,00	2.980,75	
6	Pinogaluman	849,06	1.138,00	25,00	2.139,35	
	Total	5.633,08	8.867,75	260,00	15.525,69	

Source: Bolaang, North Mongondow District Agriculture Office (2016)

Table 2 shows that the area of lowland rice (1,621.48 ha), corn (2,220 ha) and soybean (100 ha) is the widest in Sangkub District, but the area of coconut (1,078.60 ha) is the lowest.

Sampling Determination:-

Farmers as respondents are determined based on breeders who carry out independent and group production processes. Independent breeders are breeders who have beef cattle of at least two adult cattle and have been raising cattle for at least two years, have rice fields or corn land, and some are planted under coconut trees and have sold cattle, while the breeder group that are sampled are groups that have a stable and produce liquid / solid fertilizer. Based on the number of breeders who have these criteria, respondents are selected by purposive sampling according to Singarimbun and Effendi (1989) and Suma (2006), i.e. the sample is deliberately chosen with a specific purpose or criterion. This study will examine the optimization model of beef cattle business with crops in the highlands based on meeting the main criteria of respondents' farmers / breeders.

The number of cattle population in the Village Sidodadi as many as 227 ST, and the number of farmers as many as 142 people with farming patterns are corn, rice, soybean, and coconut. However, the samples in this study are farmers/ ranchers who related to integrated business activities as shown in Table 3.

The number of samples in the study location as many as 142 people, with consideration of cost and time, the sampling in this study with purposive sampling technique is sampling with certain criteria using the *Slovin* formula, Sugiaono (2010). The size of the sample is calculated using the *Slovin* formula in Uma (2003), is;

$$n = \frac{N}{N(e)^2+1} \text{..... (1)}$$

Description:

n: Number of samples

N: Population number

e: The precision used is 10% which is the degree of deviation from the characteristics of the sample to the population

$$n = \frac{142}{142(0,1)^2 + 1}$$

$$= 33$$

The results of calculations using the Slovin formula obtained the number of farmers samples as many as 33 people. The number of farmer samples in each village was determined proportionally by the following formula (Sugiono, 2014).

Based on the number of samples of breeder farmers who have criteria, then in the highlands respondents were chosen based on their farming in each business pattern with details as presented in Table 3.

Table 3:-Integrated Farming Business Patterns in the Highlands of Sidodadi Village, Sangkub District

Types of Crops	Farming Patterns				
	1	2	3	4	5
Rice	√		√		√
Corn		√	√	√	
Coconut				√	
Soybean					√
beef cattle	√	√	√	√	√

Description:. Business patterns (1 = Rice Cow, 2 = Corn-Cow, 3 = Corn Rice Cow, 4 = Coconut-Cow Corn, 5 = Cow-Rice-Soybean).

Data Collection Method:-

Data sources of data which taken in this study consisted of secondary data and primary data. Secondary data were sourced from related agencies, those are the Central Statistics Agency (BPS), the Population and Civil Registry Agency (*Dukcapil*), the Meteorology, Climatology and Geophysics Agency (BMKG), the Regional Planning Agency (*Bapeda*), and the Agriculture Agency (*Distan*). Retrieval of secondary data is done through searching of existing documents.

Primary data sourced from farmer respondents were carried out by observation (observation) in the field, interviews (interviews), and the distribution of structured questionnaires (questionnaire) with closed and open answers to respondents including characteristics of farmers, land use, labor, working capital, seeds, fertilizer , pesticides, beef cattle production, rice, corn, soybean, coconut, forage, other crops, liquid / solid fertilizer, marketing of cattle, rice, corn, soybeans, feed, liquid/solid fertilizer.

Data Analysis:-

The results of the study will be tabulated and then analyzed according to the research objectives, which analyzed by linear programming to optimize beef cattle business income with crops at highland in Sidodadi Village, Sangkub District, Bolaang, North Mongondow Regency.

Siswanto, (2002) linear programming approach is explained as follows:

Model

The objective function can be expressed mathematically as follows:

Maximum $Z = C_1X_1 + C_2X_2 + ... + C_jX_j + ... + C_nX_n$

Limiting factor:

1. Land Size: ∑ ai j j ≤. Ai
2. Labor: ∑ ij ij ij ij ≤. Bi
3. Working Capital: ∑ ij ij ij ij ij ≤ ≤ Di

Explanation:

1. Z = Profit that must be maximized
2. Xj = optimal area of the jth business type (Ha)
3. Cj = Benefits derived from the j-th type of business (Rp / year)
4. Ai = Total area of available agricultural land
5. aij = coefficient of input-output area of land cultivated
6. Bi = Workers' Day (HOK) available from every farmer household (HOK / Year)
7. bij = Workforce requirements for each type of business (HOK / year)
8. Di = Working capital available from each farm household
9. Dij = Working capital needs of each type of business
10. i = 1,2,3, ..., m
11. j = 1,2,3, ..., n

Model Constraints and Activities

Dry Land (LK)

The dry land means the land used for the production of beef cattle, maize, field rice, soybean and coconuts, forages and other crops. The area of land controlled by the owner or cultivator is assumed to be an average of 0.5 ha.

Wetlands (LB)

Wetlands are land used for the production of beef cattle and rice crops. The area of land controlled by the owner or cultivator is assumed to be an average of 0.5 ha.

Labor (TK)

availability of family labor is limited, so that it will become an obstacle in carrying out its activities. The number of available family workers is calculated based on the number of workers working in farming (HOK). The value of 1 HOK at the study site is equivalent to 7 hours of work, starting at 07.30 to 11:30 and 14:00 to 17:00.

Capital

Owned capital is calculated based on the average capital owned by farmers used for their farming, based on information obtained from farmers. These capital constraints are detailed per month and expressed in rupiah (IDR).

Research Result And Discussion:-

Characteristics of Research Respondents :-

This study was carried out at the village of Sidodadi in the highlands in Sangkub sub-district, Bolaang, North Mongondow Regency, involving 33 respondents consisting of five farming patterns, i.e. Cow-Rice (SP) farming patterns, Cow-Corn (SJ) farming patterns, Cow-Rice-Corn (SPJ) farming patterns, Cow-Corn-Coconut (SJ-Ka) farming patterns, and Cow-Rice-Soybean farming patterns (SP-to). Age of respondents based on farming patterns can be seen in Table 4.

Table 4:-Ages of Respondents

No	Farming Patterns	20-30 yr.	31-40 yr.	41-50 yr.	51-60 yr.	>60 yr.	Average
1	S-P		1		3	1	54,00
2	S-J	2	2	4		1	42,11
3	S-P-J	2	2			1	55,40
4	S-J-Ka	2	4	3			38,11
5	S-P-Ke	1		1	3		50,00

Source: Processed from primary data 2018

Table 4 data shows that the age of the oldest respondents in the Cow-Rice-Corn (SPJ) farming pattern is the average age of 55.40 years, and the age of the youngest respondent in the Cow-Corn-Coconut (SP-Ka) business pattern with the average age is 38.11 years. Mardikanto (2003) explains that the age element is very influential with the physical ability of farmers to be able to work optimally; the more age the physical strength will decrease along with the declining productivity of productive age work is an opportunity to increase production and income of farmers.

Chamdi (2003) argues that the younger the breeder's age, the higher the curiosity about something and the higher technology introduction. Whereas Soekartawi (2006), explains that older farmers are usually fanatical about tradition and it is difficult to be given an understanding that can change the way of thinking, working and adopting new technologies. This farmer is apathetic about the existence of new technology, so that it can affect the profits of his business. Table 5 presents the educational situation of the respondents based on farming patterns.

Table 5:-Education of Respondents

No	Farming Pattern	Not attending school	Not completing elementary school	Completing Elementary school	Not completing junior high school	completing junior high school	Not completing Senior high school	completing Senior high school	Not attending bachelor program	Bachelor	Average
		1	2	3	4	5	6	7	8	9	

1	S-P	1	2	1				1			3,00
2	S-J		1	5	1	1		1			3,67
3	S-P-J		2	1	2						3,00
4	S-J-Ka		1	3	1	1	1	2			4,44
5	S-P-Ke	1		4							2,60

Source: Processed from primary data

Table 5 explains that the most formal education of respondents in the business pattern of Rice-Corn-Coconut (PJ-Ka) with an average education level of 4.44 or equal to not completing junior high school, the lowest level of education in the business pattern of Cow-Rice-Soybean (SP -Ke) with an average number of 2.60 or the same as not completing elementary school. The higher the formal education level of respondent farmers is expected to be more rational in their thinking patterns and reasoning power. Higher education is expected to be easier to change attitudes and behaviours to act rationally (Mardikanto, 2003). Table 6 presents the state of respondents' experience based on farming patterns.

Table 6:-Respondents' Experiences

No	Farming Pattern	1-10 yrs.	11-20 yrs.	21-30 yrs.	31-40 yrs.	>41 yrs.	Average (yrs.)
1	S-P		2		1	2	31,20
2	S-J	2	3	2	1	1	20,56
3	S-P-J	1		1	3		29,20
4	S-J-Ka	3	5		1		15,11
5	S-P-Ke	1	2		2		26,80

Source: Processed from primary data

Based on Table 6, it is known that work experience is one of the factors that can influence a person in running a business they are involved in. The longer someone's work experience, the better in running their business. Most respondents experience in the Cow-Rice (S-P) business pattern with an average experience of raising is 31.20 years, the least experience of raising cattle in the Cow-Corn-Coconut (S-J-Ka) business pattern with an average of 15.12 years. Table 7 presents the condition of the respondents' land ownership based on farming patterns.

Table 7:-Extent of Respondents' Land Ownership

No	Farming pattern	0,5-1,5 (ha)	>1,5-2,5 (ha)	>2,5-3,5 (ha)	>3,5-4,5 (ha)	>4,5 (ha)	Average (ha)
1	S-P		1	1	2	1	3,90
2	S-J	1	2	2		4	5,00
3	S-P-J		3	2			2,70
4	S-J-Ka	1	4		1	3	3,61
5	S-P-Ke		4		1		2,70

Source: Processed from primary data 2018

Table 7 shows that the highest number of respondents in the Cow-Corn (SJ) farming pattern with an average ownership of 5.00 ha and the least ownership in the Cow-Rice-Corn (SPJ) and Cow-Rice-Soybean (SP-Ke) patterns) with an average of 2.70 ha. This shows that in the lowlands the area has more rice than the highlands, while the area of maize is wider in the highlands. Table 8 shows the condition of the number of respondents' livestock ownership based on farming patterns.

Table 8:-Number of Respondents Cattle Ownership

No	Farming pattern	Number of Cattle (Tails)						Cow cattle total (ek)	ST Average/Respondent
		Age > 1 yrs.		Age 1 -2 yrs.		Age > 2 yrs,			
		Ơ	□	Ơ	□	Ơ	□		
		5	15	22	15	56	73	186	2,96

1	S-P	1	2	1	2	6	5	17	2,38
2	S-J	1	7	7	2	11	13	41	3,19
3	S-P-J	0	2	2	2	7	5	18	2,52
4	S-J-Ka	2	4	6	1	11	10	34	2,64
5	S-P-Ke	1	4	4	1	3	6	19	2,66
		5	19	20	8	38	39	129	2,74

Source: Processed from primary data 2018

The data in Table 8 shows that the largest number of livestock populations in the Cow-Corn (SJ) business pattern with an average ownership of 3.19 ST, the least number in the Cow-Rice-Corn (SPJ) business pattern with an average number of ownership 2,52 ST.

Compilation of objective functions and constraints:-

Optimization is carried out on integrated farming systems in the highlands between cattle-rice (*Bos sondaicus-Oryza sativa)*, cattle-corn (*Bos sondaicus-Zea mays*), cow-rice-corn (*Bos sondaicus-Oryza sativa-Zea mays*), cattle - corn-coconut (*Bos sondaicus-Zea mays-Cocos nucifera*), cattle-rice-soybean (*Bos Sondaicus - Oryza sativa - Glycine max*). There are three obstacles in optimization namely land, labor and capital constraints. The first obstacle is the area of land that forms the basis of the formation of optimization.

Table 9:-Constraints of Land Area in the Highlands of Sidodadi Village (ha)

Types of Crops	Land area in farming patterns (ha)					Mean
	1	2	3	4	5	
Rice	1,2		0,50		0,5	0,73
Corn		2,10	2,00	1,44		1,85
Coconut				1,44		1,44
Soybean					0,50	0,50
Total	1,2	2,10	2,50	2,88	1,00	
Land owned	3,90	3,78	4,10	2,88	2,20	**3,37**

Source: Processed research data, 2019

Based on the data in Table 9, it can be seen that the average land use of the five types of business patterns in the highlands shows that the wider use of the business pattern (S-J) is 1.85 ha, while the lowest land use area is in the business pattern (S-P-Ke) which is 0.50 ha.

K1: $X1 + X2 + X3 + X4 + X5 \leq 3,37$

The second obstacle is family labour constraints. Table 10 presents family labour for one hectare of business pattern. The first obstacle can be formulated as follows:

Table 10:-Workers in the Sidodadi Highland Plateau

Types of Crops	TKK in farming patterns (HOK / ha / yr)					Mean
	1	2	3	4	5	
Total Land Use	1,20	2,94	1,90	2,88	1,00	
Family labor ((HOK)						
Rice	270	0	112,5	0	112,5	165
Corn		928	245	455	-	543
Coconut				260		260
Soybean					88	88

Source: Processed from primary data, 2019

Table 10 explains that the average availability of family labor (TKK) in the highlands in the corn business is 543 HOK / ha / yr and the lowest availability is in the soybean business which is 88 HOK / ha / yr. The second obstacle can be formulated as follows:

K2: 165x1 + 543x2 + 260x3 + 88x4 + 9 889

The third obstacle is business capital constraints. Table 11 presents the business for one hectare of business pattern.

Table 11:-Constraints on Business Capital in the Highlands of Sidodadi Village

Types of Crops	Land area in farming patterns (ha)					Mean
	1	2	3	4	5	
Rice	23.840.000	-	24.760.000	-	24.280.000	24.293.333
Corn		20.801.887	21.957.143	19.753.846		20.837.625
Coconut				17.823.974		17.823.974
Soybean					14.654.500	14.654.500

Source: Processed from primary data, 2019

Table 11 explains that the business capital of the four mainland commodity businesses, there is the highest average rice business commodity of Rp. 24,293,333, while the lowest use of venture capital, which named business commodities, was Rp. 14,654,500. The third obstacle can be formulated as follows:

K3: 24.293.333x1 + 20.837.625x2 + 17.823.974x3 + 14.654.500x4 ≤ 65.385.947

Purpose Function:-
Farmers' Net income per hectare per business pattern before analysis can be presented in Table 12.

Table 12:-Farmer's Net Income Before Analysis on the Sidodadi Highland Plateau

Corp type	Income in farming patterns (Rp / year / ha)					Mean
	1	2	3	4	5	
Rice	27.560.000	-	14.246.000	-	13.300.200	18.368.733
Corn		27.098.700	15.230.200	24.129.000		22.152.633
Coconut				7.256.470		7.256.470
Soybean					13.244.000	13.244.000
beef cattle	5.704.655	7.282.461	4.810.013	5.042.568	4.567.660	5.481.471
Cows	33.264.655					33.264.655
Corn Cow		34.381.161				34.381.161
Beef-Rice-Corn			34.286.213			34.286.213
Cow-Corn-Coconut				36.428.038		36.428.038
Beef-Rice-Soybean					31.111.860	31.111.860

Source: Processed from primary data

Based on Table 12 it can be seen that the net income of the cow-corn-coconut business in the highlands has the highest income, namely an average of Rp. 36,428,038 per year, while the average net income of the cattle-rice-soybean business is the lowest at Rp. 31,111,860 per year.

T: Max: 33.264.655X1 + 34.381.161X2 + 34.286.213X3 + 36.428.038X4 + 31.111.860X5

Completion of Linear Programming Optimization:-
Linear programming is one form of technical analysis using a mathematical equation model that serves to assist in achieving goals, Hartono (2016). The objective function (optimization) and constraint functions in this study can be solved by Linear Programming. Solution using the Linear Program Solver (LiPS) and Microsoft Excel software are as follows:

Table 13:-Results of Optimization of Cow-rice with Predefined Function and Purpose Functions

Functioni	Symbol	Solution		
Decision	Cow	0		ST
	Rice	2,58		ha
Purpose	Net income	32.376.281,00		IDR
	Number of Livestock	7,22		ST
	Compost	8.753,20		kg/livestock/year
	Agricultural Waste	1.804,41		kg/ha/year

Obstacles	Land	1,20		ha
	Labor	126,00		HOK
	Capital	40.978.114,29		IDR

Source: Processed research data, 2019

Recommend to crop 2.58 ha of rice, so that it will produce the following objectives:
1. Highest net income, reaching to Rp. 32,376,281 per year
2. Increasing the number of livestock kept by 7.22 ST per year
3. Utilization of livestock manure waste for fertilizer as much as 8,753.20 kg per year

Utilization of agricultural waste as animal feed as much as 1,804.41 kg per year

Table 14:-Results of Optimization of Cow-Corn with the Designated Objectives and Obstacle Functions

Function	Symbol	Solution		
Decision	Cow	2,00		ST
	Corn	1,11		ha
Purpose	Net income	25.507.057,00		Rp
	Number of Livestock	2,80		ST
	Compost	9.776,00		kg/livestock/year
	Agricultural Waste	1.260,00		kg/ha/year
Obstacles	Land	2,94		ha
	Labor	106,00		HOK
	Capital	40.828.452,84		IDR

Source: Processed research data, 2019

Recommend raising cattle 2.00 ST and corn planting covering an area of 1.11 ha, so that it will produce the following objectives:
1. Highest net income, reaching Rp. 25,50,0,057 per year
2. Increase in the number of livestock raised by 2.80 ST per year
3. Utilization of livestock manure waste for fertilizer as much as 9,776 kg per year
4. Utilization of agricultural waste as animal feed as much as 1,260 kg per year

Franke et al (2010), suggested that integrated crop and livestock farming leads to synergy between crop and livestock production thereby increasing overall productivity and agricultural production resilience.

Table 15:-Results of Optimization of Cow-Rice-Corn with the Designated Objectives and Obstacle Functions

Function	Symbol	Solution		
Decision	Cow	0		ST
	Rice	0,69		ha
	Corn	2,09		ha
Purpose	Net income	36.851.873,00		Rp
	Number of Livestock	6,23		ST
	Compost	16.225,00		kg/ekor/thn
	Agricultural Waste	1.560,89		kg/ha/thn
Obstacles	Land	1,90		ha
	Labor	196,00		HOK
	Capital	63.469.810,54		Rp

Source: Processed research data, 2019

Recommend harvesting 0.69 ha of rice and 2.09 ha of corn, so that it will produce the following objectives:
1. Highest net income, reaching Rp. 36,851,873 per year
2. Increasing the number of livestock kept by 6.23 ST per year
3. Utilization of livestock waste for fertilizer as much as 16,225.00 kg per year
4. Utilization of agricultural waste as animal feed as much as 1,560.89 kg per year

Table 16:-Results of the Optimization of Cow-Corn-Coconut with Predefined Function and Purpose Functions

Function	Symbol	Solution		
Decision	Cow	0		ST
	Corn	3,11		ha
	Coconut	0		ha
Purpose	Net income	42.787.417,00		IDR
	Number of Livestock	7,44		ST
	Compost	69.362,16		kg/livestock/year
	Agricultural Waste	4.018,00		kg/ha/year
Obstacles	Land	2,44		ha
	Labor	166,00		HOK
	Capital	55.309.280,38		Rp

Source: Processed research data, 2019

Recommending Harvest corn in an area of 3.11 ha and coconut is not recommended, so it will produce the following

Objectives:

1. Highest net income, reaching Rp. 42,787,417 per year
2. Increasing the number of livestock kept by 7.44 ST per year
3. Utilization of livestock waste for fertilizer as much as 69,362.16 kg per year
4. Utilization of agricultural waste as animal feed as much as 4,018.00 kg per year

Amin (2009), explained that coconut crops grow and bear fruit well at an altitude of 0-450 meters above sea level. Some of the land under the coconut trees in North Sulawesi is used for crop development. The government and researchers in this area are also trying to introduce forage fodder in under-utilized coconut trees. Salendu (2012).

Table 17:-Results of Optimization of Cow-Rice-Soybean with Purpose Functions and Constraints

Function	Symbol	Solution		2019
Decision	Cow	0	ST	
	Rice	0	ha	
	Soybean	3,40	ha	
Purpose	Net income	41.551.400,00	IDR	
	Number of Livestock	7,14	ST	
	Compost	21.440,40	kg/livestock/year	
	Agricultural Waste	1.904,00	kg/ha/year	
Obstacles	Land	1,00	ha	
	Labor	196,00	HOK	
	Capital	53.239.114,88	IDR	
Source: Processed research data				

Recommending harvest 3.40 ha of soybeans and rice is not recommended, so that it will produce the following

objectives:

1. The highest net income, reaching Rp. 41,551,400 per year
2. Increasing the number of livestock kept by 7,141 ST per year
3. Utilization of livestock manure waste for fertilizer as much as 21,440.40 kg per year
4. Utilization of agricultural waste as animal feed as many as 1,904.00 kg per year

Conclusion:-

Based on the results of the analysis and discussion described, it can be concluded as follows

1. Factors that are very influential in determining farm income are land area, business capital and labor (cow-rice, cow-corn, cow-rice-corn, cow-corn-coconut and cow-rice-soybean).
2. The income generated from the optimization of the cow-corn-coconut business shows the highest net income of farmers in the lowlands of Rp. 42,787,417 per year or equivalent to Rp. 3,565,618 per month, this shows that this business is optimal and meets the Need for Decent Living (KHL) and the amount is already more with the North Sulawesi UMP in 2019 which is Rp. 3,150,000 per month

3. The results of optimization of the cattle-corn-coconut business get the lowest income of Rp. 25,50,0,057 per year or equivalent to Rp. 2,125,588 per month. This effort shows that it does not meet the Need for Decent Living (KHL) and is far below the amount of UMP in North Sulawesi.

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