Quest Journals
Journal of Research in Agriculture and Animal Science
Volume 2 ~ Issue 9 (2014) pp: 17-26
ISSN(Online) : 2321-9459
www.questjournals.org

Research Paper

Optimization of Integrated Farming Systems Using Goal Programming Analysis Approach (A Study Case in Tenga, Sinonsayang and West Amurang Subdistricts, South Minahasa Regency, North Sulawesi, Indonesia)

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Received 30 September, 2014; **A**ccepted 29 November, 2014 © The author(s) 2014. Published with open access at **www.questjournals.org**

ABSTRACT:- This study aims to analyze the optimization of integrated farming system and analyze the impact of output and input prices simulation changes on the optimization of integrated farming system with goal programming analysis approach. The study was conducted in Tenga, Sinonsayang and West Amurang Subdistricts, South Minahasa Regencyon November 2011 to February 2012. The method used in this study was survey. The primary data were collected through interviews with farmers. The secondary data were collected from related offices/ agencies. There were three decision variables studied for the analysis of Goal Programming. They were the optimized coconut area, optimized corn area, and optimized rice area. The respondents were 150 people determined by purposive sampling. The data analysis used was Goal Programming (GP) for optimization testing, and for the completion of MGP data it was used WinQSB software.

The optimization results of first alternative (coconut is required to be cropped) show that in all three cropping patterns (coconut, coconut-corn, coconut rice) it isrecommended to maintain the number of crops and production of coconut (required) for the entire land area of 1.37 ha, accompanied by the cropping of corn with the area of 0.97 ha. The optimization results of second alternative (coconut-corn are required to be cropped), show that in all three cropping patterns (coconut, coconut-corn, coconut rice) it isrecommended to maintain the number of crops and production of coconut (required) for the entire land area of 1,00 ha, accompanied by the cropping of corn with the area of 1.34 ha. The optimization results of third alternative (coconut-rice are required to be cropped), show that in all three cropping patterns (coconut, coconut-corn, coconut rice) it is recommended to maintain the number of crops and production of coconut (required) for the entire land area of 1.00 ha, accompanied by the cropping of corn with the area of 0.84 ha, and corn with the area of 0.50 ha.

Keywords:- Optimization, Goal Programming, cropping patterns, coconut, corn, rice

I. INTRODUCTION

The population growth and increase in income cause the demand for livestock products continues to increase. The rate of population increase, followed by the improvement of living standard and changing of consumer tastes have changed consumption patterns that lead to increased consumption of animal protein derived from cattle. Cattle are one of the largest meat-producing livestock commodities, and belong to the types of ruminants able to consume a high-fibre feed such as forage and concentrate in large quantities (Umar, 2009). Increased demand and consumption of beef cannot be offset by an increase in domestic production, both its quality and quantity, resulting in a growing gap between demand and supply (Subagyo, 2009 in Priyanto, 2011). Efforts to increase the cattle population through beef self-sufficiency program in Indonesia, which was proclaimed since 2000, were not successful yet. Therefore, beef self-sufficiency program was relaunched through agricultural revitalization efforts targeted to be reached in 2010, but the target of both programshave not achieved yet. Unavailability land for grazing area and animal feed availability become the causes of the low number of cattle. Sianipar et al (2002) explain that the land demand for farming in Indonesia is often forced to be succumbed to the demand of land for industrial and settlement development. The depreciation of agricultural land results in the decreasing availability of land for ruminant forage growth. The decrease eventually affectsthe

cattle production decline. On the other hand, the slaughter rate of cattle is always higher than the rate of ruminant's population growth as a result of increasing demand for meat.

In North Sulawesi, cattle are raised integratedly with crops by some farmers, known as integrated crop-livestock farming systems (*integrated farming system*). Integrated system is the implementation of an integrated farming through low external input approach between cattle and crops. PRA results conducted by BPTP of North Sulawesi indicates that there are many North Sulawesi farmers who actually cultivatecoconut in polyculture or integratedly with certain livestock such as cattle and goats, however, because it is not managed well and adequately, the farming efficiency is very low (Melia et al., 2010). Many coconut lands on the coast area to a height of around 100 m above sea level is cultivated by intercrops especially corn. The land under coconut tree is also used as livestock grazing land especially cattle.

The optimal management of crop-livestock system can increase the income of farmers. Priyanti (2007) in Elly, et al. (2008), explains that cattle-livestockfarming can provide social and economic positive impacts. Integrated cropping patterns between crop-livestock in North Sulawesi are integrated cattle-corn farming in Minahasa and integrated cattle-coconut farming in South Minahasa. Yamin et al. (2010) explains, because of the wide range of integration forms to do, it is important to know the exact model according to the conditions in each area. The forms of involvement between related parties are required to know. In addition, feasibility analysis of cattle farming combined with plantation and farming needs to do.

South Minahasa Regency is one of the areas in North Sulawesi potential for the development of cattle. South Minahasa Regency has a total area of rice cropping of 15,308 ha, the total area of corn cropping of 20,882 ha, and coconut plantation area of 45,041.5 ha (Government of Minahasa Regency, 2012). The rice and corn cropping area will produce enough agricultural waste for cattle feed. It ensures the availability of adequate feed for cattle throughout the year. Vast coconut plantation area can be utilized as the cattle grazing area.

This study aims to analyze the optimization of integrated farming systems simulation and analyze the impact of output and input prices simulation changes on the optimization of integrated farming system with goal programming analysis approach

II. RESEARCH METHOD

B1. Research Setting

The study was conducted in Tenga, Sinonsayang and West Amurang Subdistricts, South Minahasa Regency in November 2011 to February 2012.

B2. Techniques of Sampling and Data Collection

The technique used to select the respondents to collect the information and knowledge was purposive. The target respondents were coconut farmers who occupied a minimum of 0.5 ha of coconut plantations, had at least 2 head of cattle and once sold their cattle. For the five farming patterns (K = non-integrated coconut, KS = coconut-cattle, KSJ = Coconut-cattle-corn, KSP = coconut-cattle-rice, and KSJP = Coconut-Cattle-Corn-Rice), it was determined to select 30 respondents in each farming, bringing the total sample of 30x5 = 150 samples.
The method used in this research was survey. The primary data were collected through interviews with farmers, and the secondary data were collected from the related offices/ agencies.

There were three decision variables that were examined for Goal Programming analysis including the variables of optimized coconut area, optimized corn area, and optimized rice area.

B3. Data Analysis

The data analysis used was Multiple Goal Programming (MGP) analysis for the optimization testing. In this study, optimization was devoted to integrated farming system between cattle and coconut accompanied by corn and/ or rice, using Win QSB software. There were two types of farming from which the best optimization would be found out, with the combination of cattle raising and coconut, that were the types of corn and rice. In this MGP analysis, the optimization goals to be achieved were constraints, therefore the optimization goals in this study served as goals constraints.MGP was prepared to achieve some goals consisting of several activity alternatives and resource constraints which were analyzed at the level of farmers. There were six objectives/ goals to be achieved in this, they were:

1. To maximize the income,
2. To maximize the income of cattle
3. To maximize the cost of raising cattle
4. To maximize the cost of coconut production,
5. To maximize the cost of corn production,
6. To maximize the cost of rice production

Functional constraints were constraints becoming barriers in achieving the goals, in this study there were several functional constraints such as:
1. Limited land ownership area
2. Limited household labour
3. Must be accompanied by coconut

To make the decision of what kind of crops among coconut ($\mathbf{X_1}$), corn ($\mathbf{X_2}$), rice ($\mathbf{X_3}$), it was taken 3 farming patterns as follows:

Farming pattern 1 was the pattern of coconut cropping and cattle raising, farming pattern 2 was the pattern of coconut and corn cropping, as well as cattle raising, farming pattern 3 was the pattern of coconut and rice cropping as well as cattle raising, farming pattern 4 was the pattern of coconut and corn and rice cropping. The optimization would provide recommendations of which farming pattern that could maximize the income and minimize the costs. In the matrix, they are presented as follows:

Table 1. Matrix of Six Farming Patterns on Five Types of Crops

	X_1	X_2	X_3	Sign	RHS
Goals					
T1	a_{11}	a_{12}	a_{13}	Max	
T2	a_{21}	a_{22}	a_{23}	Max	
T3	a_{31}	a_{32}	a_{33}	Min	
T4	a_{41}	a_{42}	a_{43}	Min	
T5		a_{52}		Min	
T6			a_{63}	Min	
Constraints					
K1	b_{11}	b_{12}	b_{13}	<=	c_1
K2	b_{21}	b_{22}	b_{23}	<=	c_2
K3	b_{31}			>=	c_3
K4		b_{32}		>=	c_4
K5			b_{33}	>=	C_5

Description: sign is the explanation of the goals and constraints, while RHS is *right hand side* (RHS), that is the right side of equation.

To test the research hypothesis, it was needed scenario, that was the sensitivity of MGP test results. The sensitivity from the results of MGP analysis needed some scenarios. There were two scenarios to be tested for sensitivity analysis as follows: Scenario 1 Changes in selling prices of cattle, that were decreased and increased by 10 % and 20 % with fixed production costs, Scenario 2 Changes in selling prices of crops (rice, corn, coconut) which were decreased and increasedby 10 % and 20 % with fixed production costs.

III. RESULTS AND DISCUSSION

C1. Description of Research Variables

Of the results of survey, it is known that there are three farming patterns which are quite dominant conducted by farmers in Tenga, Sinonsayang and West Amurang Subdistricts, South Minahasa Regency, North Sulawesi, Indonesia. The three common farming patterns are: (1) coconut and cattle, (2) coconut and corn, (3) coconut, rice and cattle. This suggests the presence of integrated farming between crop and cattle conducted by farmers in the research site.

Table 3: State of Farming in the research site

No	Types of Crop	Cropped Area (Ha)	Harvested Area (Ha)	Production (ton)	Mean of Production (ton/ha)
1	Wetland rice	13,031	13,018	72,080	5.54
2	Dryland rice	2,227	1,574	4,205	2.67
3	Corn	20,888	20,882	82,330	3.94
4	Cassava	273	285	3,791	13.30
5	Sweet Potatoes	200	197	1,917	9.73

6	Peanuts	432	773	1,096	1.42
7	Coconut	45,041	45,041	49,375	1.33
8	Clove	19,585	19,585	13,215	0.67
9	Other	20,561			
		102,805	81,560	152,752	

The conditions of environment and climate in South Minahasa support the agricultural development in this Regency. The agricultural sectors in this Regency include food crops, vegetables, ornamental plants, fruits and plantation. In general, food commodities cultivated by people are rice (wetland rice and dryland rice), corn, cassava, sweet potatoes, peanuts, and soybeans. The productivity of vegetable crops in 2011 in South Minahasa Regency is not changed significantly when compared to 2010. Production of fruit crops in South Minahasa District consists of rambutan, guava, pineapple, orange, Duku, avocado, papaya, mango, mangosteen, jackfruit, and banana. The most fruit productions in South Minahasa Regency are bananas and rambutan.

Table 3 shows that in Minahasa South Regency, the largest cropped area is coconut reaching 45,041 ha, with the production value of 49 375 tons. Corn is a crop that has the largest harvested area among other crops, equal to 20,882 with the production of 3.94 tons per hectare. Wetland rice has cropped area of 13,031 hectares, with 13,018 hectares of harvested area, with the production of 72,080 tons, so that the average production is equal to 5.54 tons/ ha. Coconut crop has the greatest cropped area in South Minahasa Regency, because this Regency district is one of the central areas of coconuts in North Sulawesi. Coconut crops in this area are mostly in the type of local coconut and small portion of hybrid coconut, which is mostly cultivated as a people plantation (Abdurachman and Mulyani, 2003).

Table 4: State of Livestock in the research site

No	Subdistricts	Cattle	Horse	Goat	Pig
1.	Amurang	184	30	207	1,267
2.	West Amurang	1,710	15	228	1,867
3.	East Amurang	435	10	-	1,050
4.	Tareran	410	10	-	1,980
5.	Tenga	2,585	-	296	2,500
6.	Sinonsayang	2,170	-	594	2,180
7.	Tumpaan	452	35	257	1,621
8.	Tatapaan	1,308	-	265	878
9.	Motoling	450	-	-	964
10.	Kumelembuai	794	-	-	2,145
11.	Ranoyapo	803	13	-	2,474
12.	Tompasbaru	770	15	286	973
13.	Maesaan	1,400	15	262	980
14.	Modoinding	160	-	-	646
15.	East Motoling	835	-	-	1,343
16.	West Motoling	860	-	-	986
17.	Suluun Tareran	620	-	-	2,124
	Total	**15,946**	**143**	**2,395**	**25,978**

Cattle are important livestock in South Minahasa Regency. Cattle population is the second highest population after pigs. In South Minahasa Regency, the purpose of raising cattle is not only used as a meat producer, but also as a means of transportation and animal labour to cultivate the land such as ploughing farmland like wetland field, dry land field, or farms. Cattle as meat the producer, based on the data from South Minahasa in Figures 2012 show that the results of cattle are able to provide meat for consumption by 246,566kg.

Wavy and hilly land conditions make the means of transportation to and from the farms complicate other means of transportation, so that cattle are used to pull carts to and from the farms. Ox carts are used to transport agricultural facilities such as fertilizer to the farms, and transport the harvest from the farms into the house. Ox cart is a means of transportation that is cheap and economical. Therefore cattle population is spread evenly in all sub districts in South Minahasa Regency (Table 4). The roles of cattle in agriculture are as farming labour in land preparation such as ploughing farms and agricultural product transportation. In agriculture and plantations, cattle play a very important.

Cattle also produce cattle dung that can be used as organic fertilizer for farming and plantation. Utilization of cattle dung as organic fertilizer can reduce the need for inorganic fertilizers, thereby reducing the cost of purchasing fertilizer and can maintain land fertility. Application of organic fertilizer to the land can increase crop production thereby increasing farmers' income.

C2. Analysis of Goal Programming

Three farming patterns used for optimization in this study are (1) coconut and cattle, (2) coconut and corn, (3) coconut, rice and cattle. Optimization off arming with a wide selection of farming patterns is used to achieve several goals, i.e. to (T1) maximize farmers income, (T2) Maximize income from cattle, (T3) Minimize cattle raising costs, (T4) Minimize the cost of coconut production, (T5) Minimize the cost of corn production, and (T6) Minimize the cost of rice production.

Of farming optimization to be achieved, there are several constraints to be considered, namely (K1) limited land ownership area, (K2) limited household labour, (K3) must be accompanied by coconut. Land is a constraint that occurs almost everywhere both in terms of land area or quality, as well as the availability of household labour of which recently the household budget is getting smaller so that the availability of household labour becomes the constraint. Based on interviews and analysis that has been done, it is obtained the formulation as shown in Table 5, showing multiple goal programming (MGP) formulation with decision variables as follows:

X1: optimized coconut area (ha)
X2: optimized corn area (ha)
X3: optimized rice area (ha)

Table 5: Formulation of the function of goals and constraints of first alternative of the research

Variables	X_1	X_2	X_3	Direction	R.H.S.
T1	6,149,616	8,287,997	6,945,392	Max	
T2	4,332,042	3,235,447	3,254,868	Max	
T3	367,553	183,558	207,564	Min	
T4	1,469,256	1,044,026	1,015,059	Min	
T5		2,650,246		Min	
T6			2,657,161	Min	
K1	1	1	1	≤	2.340
K2	23.72	62.49	54.23	≤	109.550
K3	1			≥	1.373
K4		1		≥	0
K5			1	≥	0

Table 6: The optimization results of Alternative 1 of Multiple Goal Programming

Symbol	Solution
Decisions (ha) :	
Coconut (X_1)	1.37
Corn (X_2)	0.97
Rice (X_3)	0
Goals :	
To maximize the farmers income (T1) Rp/year	16,464,330
To maximize the income of cattle (T2) Rp/ year	9,073,281
To minimize cattle raising costs (T3) Rp/ year	681,598
To minimize the cost of coconut production (T4) Rp/ year	3,025,586
To minimize the cost of corn production (T5) Rp/ year	2,570,738
To minimize the cost of rice production (T6) Rp/ year	0
Constraints :	
Land Area (K1) ha	2.34
Household Labour (K2) HOK/year	93

The optimization results of alternative 1 (coconut is required to be cropped) based on Table 6, shows that in all three cropping patterns (coconut, coconut-corn, coconut rice) it is recommended to maintain the number of crops and production of coconut (required) for the entire land area of 1.37 ha, accompanied by cropping corn with the area of 0.97 ha.

If converted by 90 percent and 40 percent, the actual reality is that 1.80 ha will produce the following goals:

1. The highest agricultural product income (coconut and corn) reaches Rp 16,464,330 per ha per year,
2. The highest cattle raising income reaches Rp 9,073,281 per ha per year,
3. The lowest cattle raising cost reaches Rp 681,598 cattle per ha per year.
4. The lowest coconut production cost reaches Rp 3,025,586 per ha per year,
5. The lowest corn production costreaches Rp 2,570,738 per ha per year,
6. The lowest rice production cost reaches Rp 0 per ha per year (the optimization does not recommended to cultivate rice).

Table 7: Formulation of function ofgoals and constraints of the second alternative of research

Variables	X_1	X_2	X_3	Direction	R.H.S.
T1	6,149,616	8,287,997	6,945,392	Max	
T2	4,332,042	3,235,447	3,254,868	Max	
T3	367,553	183,558	207,564	Min	
T4	1,469,256	1,044,026	1,015,059	Min	
T5		2,650,246		Min	
T6			2,657,161	Min	
K1	1	1	1	≤	2.340
K2	23.72	62.49	54.23	≤	109.550
K3	1			≥	1.000
K4		1		≥	0.500
K5			1	≥	0

Table 8: The optimization results of second alternative between crops and beef cattle with the land area of 1 ha

Symbol	Solution
Decisions (ha) :	
Coconut (X_1)	1.00
Corn (X_2)	1.34
Rice (X_3)	0
Goals :	
To maximize the farmers income (T1) Rp/year	17,255,532
To maximize the income of cattle (T2) Rp/ year	8,667,541
To minimize cattle raising costs (T3) Rp/ year	613,520
To minimize the cost of coconut production (T4) Rp/ year	2,868,250
To minimize the cost of corn production (T5) Rp/ year	3,551,329
To minimize the cost of rice production (T6) Rp/ year	0

The optimization results of alternative 2 (coconut-corn are required to be cropped) based on Table 8, shows that three cropping patterns (coconut, coconut-corn, coconut rice) it is recommended to maintain the number of crops and production of coconut (required) for the entire land area of 1.00 ha, accompanied by corn cropping with the area of 1.34 ha.

If converted by 90 percent and 40 percent, the actual reality is that 1.80 ha will produce the following goals:

1. The highest income of agricultural product (coconut and corn) reaches Rp 17,255,532 per ha per year,
2. The highest income of cattle raising reaches Rp 8,667,541 per hectare per year,
3. The lowest cattle raising costs reaches Rp 613,520 per ha per year.
4. The lowest coconut production costs reaches Rp 2,868,250 per hectare per year,
5. The lowest corn production costs reaches Rp 3.551.329.50 per ha per year,

The lowest cost of rice production reaches Rp 0 per ha per year (the optimization does not recommend to cultivate rice).

Table 9: Matrix of Goals and Constraint of Alternative 3 of MGP Optimization

Variables	X_1	X_2	X_3	Direction	R.H.S.
T1	6,149,616	8,287,997	6,945,392	Max	
T2	4,332,042	3,235,447	3,254,868	Max	
T3	367,553	183,558	207,564	Min	
T4	1,469,256	1,044,026	1,015,059	Min	
T5		2,650,246		Min	
T6			2,657,161	Min	
K1	1	1	1	≤	2.340
K2	23.72	62.49	54.23	≤	109.550
K3	1			≥	1.000
K4		1		≥	0
K5			1	≥	0.500

Table 10: The Optimization Results of Alternative 3 of Multiple Goal Programming

Symbol	Solution
Decisions (ha) :	
Coconut (X_1)	1.00
Corn (X_2)	0.84
Rice (X_3)	0.50
Goals :	
To maximize the farmers income (T1) Rp/year	16,584,229
To maximize the income of cattle (T2) Rp/ year	8,677,251
To minimize cattle raising costs (T3) Rp/ year	625,523
To minimize the cost of coconut production (T4) Rp/ year	2,853,767
To minimize the cost of corn production (T5) Rp/ year	2,222,206
To minimize the cost of rice production (T6) Rp/ year	1,328,580

The optimization results of alternative 3 (coconut-rice are required to be cropped) based on Table 10, shows that in all three cropping patterns (coconut, coconut-corn, coconut rice) it is recommended to maintain the number of crops and production of coconut (required) for the entire land area of 1.00 ha, accompanied by corn cropping with the area of 0.84 ha, and corn with the area of 0,50 ha.

If converted by 90 percent and 40 percent, the actual reality is that 1.80 ha will produce the following goals:

1. The highest income of agricultural product (coconut and corn) reaches Rp 16,584,229 per ha per year,
2. The highest income of cattle raising reaches Rp 8,677,251 per hectare per year,
3. The lowest cattle raising reaches Rp 625,523 per ha per year.
4. The lowest coconut production cost reaches Rp 2,853,767 per ha per year,
5. The lowest corn production cost reaches Rp 2,226,206 per hectare per year,
6. The lowest rice production cost reaches Rp 1,328,580 per ha per year.

Of the three alternatives, if combined, the results are as follows:

Table 11. The optimization results of three alternatives of Multiple Goal Programming

Function	Alternative 1	Alternative 2	Alternative 3
Income	25.537.611	25.923.073	25.261.480
Cost	6.277.922	7.033.099	7.030.076
Difference	19.259.689	18.889.974	18.231.404

These analysis considers the testing of overall decision variable (resources) considering the goals achievement process to achieve the highest income, and achieve the lowest cost. Through three alternatives, they are to: 1) include coconut as a farming that must be cropped, 2) include coconut-corn as a farming that must be cropped, and 3) include coconut-rice as a farming that must be cropped, it is obtained optimal results by including the results of alternative 1.

The above results show that the optimization that can maximize income and minimize costs is alternative 1, generating the income of agricultural product and cattle raising amounted to Rp 25,537,611 and the cost of Rp 6,277,922. The optimization results of alternative 1 (coconut is required to be cropped) based on Table 11, shows that in all three cropping patterns (coconut, coconut-corn, coconut rice) it is recommended to maintain the number of crops and production of coconut (required) for the entire land area of 1.37 ha, accompanied by corn cropping with the area of 0.97 ha.

C3. Impacts of Output and Input Prices Simulation Changes on the Optimization of Integrated Farming System

Of the results of MGP analysis, it is needed to do several scenarios to get the policy in agriculture/ livestock in order to increase the results of livestock-farming optimally.
There are two scenarios that have been tested for sensitivity analysis, with the results of analysis as follows:

Scenario 1 Changes in selling prices of cattle that are decreased and increased by 10 percent and 20 percent with fixed production costs.

Table 12. The results of Scenario 1

Goals	Initial Values	Scenario	%
10% Increase			
To maximize the farmers income (T1)	16,464,330	16,464,330	0
To maximize the income of cattle (T2)	9,073,281	9,705,689	6.97
To minimize cattle raising costs (T3)	681,598	641,179	-5.93
To minimize the cost of coconut production (T4)	3,025,586	3,025,586	0
To minimize the cost of corn production (T5)	2,570,738	2,570,738	0
To minimize the cost of rice production (T6)	0	0	
20% Increase			
To maximize the farmers income (T1)	16,464,330	16,464,330	0
To maximize the income of cattle (T2)	9,073,281	10,338,096	13.94
To minimize cattle raising costs (T3)	681,598	600,829	-11.85
To minimize the cost of coconut production (T4)	3,025,586	3,025,586	0
To minimize the cost of corn production (T5)	2,570,738	2,570,738	0
To minimize the cost of rice production (T6)	0	0	
10% Decrease			
To maximize the farmers income (T1)	16,464,330	16,464,330	0
To maximize the income of cattle (T2)	9,073,281	8,505,294	-6.26
To minimize cattle raising costs (T3)	681,598	727,538	6.74
To minimize the cost of coconut production (T4)	3,025,586	3,025,586	0
To minimize the cost of corn production (T5)	2,570,738	2,570,738	0
To minimize the cost of rice production (T6)	0	0	
20% Decrease			
To maximize the farmers income (T1)	16,464,330	16,464,330	0
To maximize the income of cattle (T2)	9,073,281	7,937,306	-12.52
To minimize cattle raising costs (T3)	681,598	773,477	13.48
To minimize the cost of coconut production (T4)	3,025,586	3,025,586	0
To minimize the cost of corn production (T5)	2,570,738	2,570,738	0
To minimize the cost of rice production (T6)	0	0	

Table 12 shows the analysis results of Scenario 1, in which 10 percent of cattle selling price will be able to increase 6.97 percent of income from cattle, and reduce5.93 percent of cattle raising costs. An increase of 20 percent of cattle selling price will be able to reduce 13.94 percent of cattle income, and lower 11.85 percent of cattle raising cost.

On the other hand, 10 percent reduction in the selling price of cattle will be able to reduce 6.26 percent of cattle income, 6.74 percent of cattle raising cost. 20 percent reduction in the selling price of cattle will be able to reduce 12.52 percent of cattle income, and increase 13.48 percent of cattle raising cost.

Increased20 percent of crop selling price will be able to increase 13.39 percent of crop income, and reduce 11.17 percent of coconut production cost and 12.84 percent of corn production cost. On the other hand, 10 percent reduction in the selling price of crop will be able to reduce 4.69 percent of crop income, and increase 3.68 percent of coconut production cost and 3.74 percent of corn production costs. 10 percent reduction in crop selling price will be able to reduce 9.38 percent of crop income, and increase 7.35 percent of coconut production costs and 7.47 percent of corn production costs.

Scenario 2 Changes in selling prices of crops (rice, corn, and coconut), that are decreased and increased by 10 per cent and 20 per cent of with fixed production costs.

Table 13 shows the analysis results of Scenario 2, in which 10 percent increase in the selling price of crops will be able to increase 6.70 percent of crop income, 5.58 percent of coconut production cost and 6.42 percent of corn production costs.

Table 13. The results of Scenario 2

Goals	Initial Values	Scenario	%
10% Increase			
To maximize the farmers income (T1)	16,464,330	17,567,440	6.7
To maximize the income of cattle (T2)	9,073,281	9,073,281	0
To minimize cattle raising costs (T3)	681,598	681,598	0
To minimize the cost of coconut production (T4)	3,025,586	2,856,758	-5.58
To minimize the cost of corn production (T5)	2,570,738	2,405,697	-6.42
To minimize the cost of rice production (T6)	0	0	
20% Increase			
To maximize the farmers income (T1)	16,464,330	18,668,904	13.39
To maximize the income of cattle (T2)	9,073,281	9,073,281	0
To minimize cattle raising costs (T3)	681,598	681,598	0
To minimize the cost of coconut production (T4)	3,025,586	2,687,628	-11.17
To minimize the cost of corn production (T5)	2,570,738	2,240,655	-12.84
To minimize the cost of rice production (T6)	0	0	
10% Decrease			
To maximize the farmers income (T1)	16,464,330	15,692,153	-4.69
To maximize the income of cattle (T2)	9,073,281	9,073,281	0
To minimize cattle raising costs (T3)	681,598	681,598	0
To minimize the cost of coconut production (T4)	3,025,586	3,134,507	3.60
To minimize the cost of corn production (T5)	2,570,738	2,666,884	3.74
To minimize the cost of rice production (T6)	0	0	
20% Decrease			
To maximize the farmers income (T1)	16,464,330	14,919,976	-9.38
To maximize the income of cattle (T2)	9,073,281	9,073,281	0
To minimize cattle raising costs (T3)	681,598	681,598	0
To minimize the cost of coconut production (T4)	3,025,586	3,247,967	7.35
To minimize the cost of corn production (T5)	2,570,738	2,762,772	7.47
To minimize the cost of rice production (T6)	0	0	

Of the above simulation results,the best is with 20 % selling price of cattle, that will achieve cattleincome increase by 13.94 %. Through scenario 2, with 20 % increase in commodity prices (corn-coconut), it will increase 13.39 % farmers income. Thus, the government would be able to provide a market stimulus by increasing the selling price of cattle as well as increasing the commodity prices cultivated, they arecoconut and corn.

IV. CONCLUSION

Conclusions of this study are as follows: Integrated crop-livestock farming system with cattle-corn-coconut provides optimal income and funding through cattle-coconut-corn farming system. Optimization to maximize income and minimize cost is by cattle-coconut-corn farming system (without including rice), which

generates income of agricultural and cattle raising amounted to Rp 25,537,611 and the cost of Rp 6,277,922.Changes in output prices and input prices provide impacts on income and fundingin the optimization of integrated farming system. The best simulation result is with 20 % selling price of cattle, that will achieve the increase in cattle income by 13.94 %. Through scenario 2, with 20 % increase in commodity prices (corn-coconut), it will increase 13.39 % farmersincome. Thus, the government would be able to provide a market stimulus by increasing the selling price of cattle as well as increasing commodity prices cultivated, namely coconut and corn.

REFERENCES

[1]. BPS, 2009. *Indonesia in Figures*. Central Bureau of Statistics Indonesia. Jakarta (in Indonesian).

[2]. BPS of North Sulwesi, 2013. Statistical Official News of North *Sulawesi Province No. 52/09/71/Th. VII, 2 September 2013*. Central Bureau of Statistics Indonesia, Manado (in Indonesian).

[3]. Diwyanto, K., R. Bambang and D. Lubis. 2001. Integrated Crops-Livestock in the Competitive, Sustainable, and People. *National Seminar on Livestock and Veterinary2001*. pp. 17-26 (in Indonesian).

[4]. Elly, F.H., B.M. Sinaga., S.U. Kuntjoro and N. Kusnadi. 2008. The Development of Local Cattle Farming through Integrated Cattle-Crops in North Sulawesi. *Agricultural Research and Development Journal*. 27(2):63-68 (in Indonesian).

[5]. Haryanto, B. 2009. Innovation of Cattle Feed Technology in Waste-Free Integrated Crops-Livestock System in Supporting Efforts to Increase Meat Production.*Agricultural Innovation Development*. 2(3):163-176 (in Indonesian).

[6]. Malia, I.E., P.C. Paat, Aryanto and Bahtiar. 2010. Feasibility of Corn-Cattle-Coconut Farming System. *Proceeding of National Cereals Week*. pp. 607-618 (in Indonesian).

[7]. Paat, P.C. 2009. Integrated Crops-Livestock in Coconut Based Dryland in North Sulawesi. *Regional Seminar on Agricultural Technology Innovation to Support Agricultural Programs of North Sulawesi*. pp. 404-412 (in Indonesian).

[8]. Priyanto, D. 2011. Development Strategy of Beef Cattle Farming in Supporting Beef and Buffalo Self-Sufficiency Programs 2014. Agricultural *Research and Development Journal*. 30(3):108–115 (in Indonesian).

[9]. Sianipar, J., L.P. Batubara and A. Tarigan. 2002. Economic Potential Analysis of Waste and Oil Palm Plantation Byproducts as Meat Goat Feed.*Workshop on Meat Goat*. pp. 201-207 (in Indonesian).

[10]. Umar, S., 2009. Oil Pal Plantation Potential as the Development Centre of Beef Cattle in Revitalizing and Accelerating Sustainable Livestock Development.*Inauguration Speech of Professor at North Sumatera University.* Medan(in Indonesian).

[11]. Yamin, M., Muhakka and A. Abrar. 2010. Feasibility of Integrated Cattle-Oil Palm Plantation System in South Sumatera Province.Human Development Journal. 10 (1): 21(in Indonesian).