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RESEARCH ARTICLE

CHARACTERISTICS OF CORN FARMING INCOME WITH INTEGRATION SYSTEM (CORN-CATTLE) AND NON-INTEGRATION IN BONE BOLANGO, GORONTALO, INDONESIA

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ABSTRACT

The crop-livestock integration system in principle considers socially acceptable aspects of sustainability (socially acceptable), economically feasible and politically desirable. This study aims to analyze the income characteristics of maize farming with crop-livestock (corn-cattle) and non-integration systems. Characteristics of the type of farming consist of two groups, namely farmers who have integrated corn and cow, as well as farmers who only cultivate maize singly. The data used were primary data obtained from 30 farmers of corn-cattle integration and 30 corn farmers, by interview and questionnaire method. The data were then processed using the Z test statistic different from the two population averages, income analysis and R/C Ratio. The results showed that the income earned by farmers who integrated livestock of maize-cattle was significantly different from the income of non-integration farmers, between the income of corn integration and non-integration corn as well as between the income of corn-cow integration and non-integration. From income value and R/C ratio of crop-livestock integration conducted by farmer able to increase value of return cost and higher than corn farmer return.

INTRODUCTION

The decision to choose an integrated system (IS) is determined by the knowledge and supply chain of infrastructure, which plays an important role especially at the beginning of IS, as it is close to the IS site and grain and cattle processing facilities (Gil, Garrett, and Berger, 2016). The application of crop-livestock integration (CLI) utilizing synergies between livestock systems, resilience, efficiency and productivity is only applicable to certain species, overall efficiency and productivity are more dependent on natural activities than CLI management practices (Stark et al., 2016). But the IMPACT system analysis, a generic database at the household level for integrated cattle-livestock integration can meet the demanding needs for more coherent integration, global data collection and improved data sharing from research and development outcomes in countries developing (Herrero et.al, 2017). Furthermore, the bio-economic model in agriculture based on the optimization of the utility function captures that integration of cattle through the activity and introduction of the DMC system provides an additional source of animal feed in the dry season which is cheaper than the purchase of concentrate feed, thereby reducing costs and increasing household net income (Alary, et.al, 2016). In addition, dynamic economic modeling of crop-livestock integration by incorporating management practices such as fertilization, fungicide and liming treatment suggested that (i) growing pest pressure can increase crop production and crop combinations, while (ii) market prices largely determine cattle-plants in integration plans and certain management practices (Liu, et.al, 2016). From the previous findings has not been explained the integration of crop-livestock associated with income. Whether cattle plant integration provides the same or different income compared to non-integration, an approach based on the utilization of production resources, especially the utilization of livestock and manure in integrated farming, as compared to non-integration, will be shown to increase productivity and home income ladder of farmers so that system integration of crop-livestock is a concept of zero waste system and good for environmental sustainability. Integrated systems of integrated crops can increase the content of organic matter in soils that increase agricultural production, allow for higher stocking rates of livestock in grasslands, and rehabilitate degraded pastures while reducing greenhouse gas emissions (Gil, Garrett, and Berger, 2016 and Gil, Siebold, and Berger, 2015). Prawiradiputra (2004) stated that most farmers in Indonesia

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were not able to utilize it optimally, the various resources available in the farming system. The allocation of resources controlled by the farmers was often not optimal and the management of the business becomes inefficient with relatively low productivity level which in turn will have an impact on the achievement of not maximal income (Asmara, 2002). Handayani (2009) explained that the problems that arise in the implementation of crop-livestock integration program are both technical and non-technical such as limited land and capital. While the problems that are technical in the form of behavior of farmers who do not apply the package integration technology that has been set. In addition to land and capital constraints, the availability of labor is also a constraint in the implementation of crop-livestock integration. Gorontalo Province is one of the provinces selected to implement a crop-livestock systems integration program that is specifically concentrated in three districts of Bone Bolango, Gorontalo, and Boalemo (Directorate General of Animal Husbandry and Animal Health, 2012). The election of Gorontalo Province is one of the locations of the program because of its agricultural and livestock potential so that it becomes a development priority which is expected to increase economic growth. The main commodities cultivated by the people of Gorontalo are corn. In addition, to the main production of these types of plants, the waste can also be used as cattle feed. The pattern of cattle development in Gorontalo Province is a model of integration of cattle with corn crops (Bappeda Gorontalo Province, 2015).

The development of livestock in Gorontalo is supported by the increase of cattle population in 2011-2016 with the average population growth reaching 10.71% (BPS Gorontalo Province, 2016), and the production of maize which has increased relative since 2007-2015. Maize production in Gorontalo experienced a relative increase of 12.35%. This condition supports the implementation of corn-cow cattle integration program. In 2014, an innovative system of corn, sugarcane and cattle integration were developed by model demonstration plot and field meeting to increase corn and cow production by more than 20%. This assessment activity was carried out because based on the facts in the field that there is no synergism between corn and cattle in Gorontalo. Livestock has not been utilized as corn crop and maize crop waste have not been used as feed and concentrate cattle, even just burned (Zubair, 2014). Likewise with the principle of implementation, the system of corn integration with cattle carried out in Gorontalo, not in accordance with the implementation principle set. Other facts stated that Gorontalo has potential of feed utilization from agricultural high waste that is equal to 2,471,770 tons compared to feed requirement of 439,884 and has an index of Agricultural Waste Supporting Capacity (IDDLP) of 5.62. This indicates that Gorontalo is a very safe category for livestock feed so there is still a great opportunity to increase the number of livestock (Rouf, 2014). Based on the description above, the utilization of cattle dung as fertilizer for agricultural crops in this case corn and utilization of corn waste as cattle feed become important to be developed, considering the utilization of resources in the system of crop-livestock integration is not optimal.

METHODS

The study was conducted in Bone Bolango, Gorontalo Province. The selection of research sites was conducted with the consideration that the Regency has the number of farmers who mostly have corn and cattle farming. The data used were primary data collected through interviews to farmers using questionnaires. Respondents used in this study amounted to 60 people who were divided into two groups. The first group consisted of 30 farmers who did corn farming with the system of integration (corn-cattle). The second group consisted of 30 single farming farmers who only did corn farming (corn farmers). The observed variables are farming characteristics and income earned by farmers during one growing season for corn (3-4 months) and one period for cow cattle (6 months). Characteristics of farming consisted of variable amount of production, land area (ha), and number of livestock (tail). The variables of the farmers 'income from the two groups were then compared to find out whether the farmers' group of corn cattle-livestock integration had different incomes from the corn farmers. In this study, partial budget analysis is used to calculate the income and expenses incurred by farmers in one season of corn planting and one period of cattle. Net income is calculated by: NI = TR – TC, NI: net income; TR: total revenue; TC: total cost Another criterion used in this partial budget analysis is the R/C Ratio Analysis (Return of Cost Ratio), which is the ratio between revenue and Total Cost. The value of R/C ratio can be known whether the farm is profitable or not. R/C ratio can be formulated as follows:

R/C Ratio = TR/TC; where if:
R/C Ratio > 1, profitable farming
R/C Ratio = 1, even farming
R/C Ratio < 1, loss farming

The analysis of income differences between the two groups used the z-test of two average populations. This test uses a two-way hypothesis test, which is H0: $\mu 1 = \mu 2$ which means there is no difference in the mean between the two samples, and H1: $\mu 1 \neq \mu 2$, i.e. there is a difference in the mean between the two samples. The rule taken to make a decision is to reject H0 if the value of Z arithmetic> Z list at the 0.05 level means the income level of the crop-livestock integration group is not the same as the non-integration farmer group and accept H0 if the Z value <arithmetic <Z lists at the 0.05 level, means the income level of the crop-livestock integration group is the same as the non-integration farmer group. Meanwhile, the average of income difference of cattle-corn farmers and the average of non-integrated income of corn farmers (single farm) can be calculated statistically using the formula:

$$Z = \frac{\bar{X}1 - \bar{X}2}{\sqrt{\frac{S1^2}{n1} + \frac{S2^2}{n2}}}$$

The test scores obtained are compared with the Z table/list then drawna conclusions. Conclusion is received H0 if the value of Z arithmetic ≤ Z table /list, while the conclusion rejected H0 when Z arithmetic> Z table / list.

RESULTS AND DISCUSSION

Characteristic of farmers

Maize plant in Bone Bolango is an area of 2000 ha which has been exploited by farmers from 15.122 ha of potential land.

Table 1.The Average of Land Ownership and Production of Maize Farmers Non-Integration in Bone Bolango, 2018

The wide range of land (Ha)	The average of production (Kg)	The number of People	The production percentage (%)
0.0 – 0.2	1250.00	5	16.67
0.3 – 0.5	1885.42	12	40.00
0.6 – 0.8	2820.31	8	26.67
0.9 – 1.1	3208.33	3	10.00
1.2 – 1.4	3531.25	2	6.67
Min 0.2	1000		
Max 1.4	3750	30	100.00
Mean0.573	2270.83		

Table 2.The Average of Land Ownership, Production and Ownership Livestock Farmers Integration of Corn-Cattle in Bone Bolango, 2018

	Corn			Cattle		
Range (Ha)	Production mean (kg)	The number of people	Production percentage (%)	The number of cows	The number people	Production percentage (%)
0.0 – 0.4	1416.67	6	20	2 – 3	19	63.33
0.5 – 0.9	2388.89	9	30	4 – 5	7	23.33
1.0 – 1.4	5153.85	13	43.33	6 – 7	3	10
1.5 – 2.0	7500	2	6.67	8 – 9	1	3.33
Min 0.25	1000			2		
Max 2.0	8000	30	100	9	30	100
Mean 0.775	3733.33			5		

Table 3. Statistics of Z Test Income of Non-Integrated Maize Farming and Maize Farming Integration, 2018

The information	Types of maize	N	Deviation standard	Sd^2
The income	UT. Maize (single)	30	3175284.172	1.00824E+13
	UT. Maize(Integration)	30	3793067.361	1.43874E+13
Statistical Test				The income
Z. counting				6,31
Z. table (0,05)				1,96

Table 4. Partial Analysis of Non-Integrated Farmer's Maize (Single Farming) and Farmer Integrated Corn Farming, 2018

Corn farming (single) Per ha / season		Corn farming (Integration) Per ha / season	
Income 3960.77 kg x Rp.3700	Rp.14,654,849	Increased income 22% (impact fertilization) 4817.20 kg x Rp.3700	Rp.17,823,640
The cost - without compost		The cost / Ha - using compost from cow	
- Variable cost (seeds, an organic fertilizer, drugs and TK)	Rp. 8,835,333	- variable cost (seeds, an organic fertilizer, drugs and TK	Rp. 6,187,035
		The cost of fertilizer decreased 30%	
- Fixed cost (land tax)	Rp. 168,000	- Fixed cost (land tax)	Rp. 168,000
Total cost	Rp. 9,003,333	Total cost	Rp. 6,355,035
Income	Rp. 5,651,516	Income	Rp.11,468,605
R/C Ratio	1.62	R/C Ratio	2.81

Table 5. The Z Test of Farming Income of Farmers non Integration (Single Farming) and Corn Farming Integration, 2018

The information	The types of corn	N	Deviation standard	Sd^2
The Income	Corn farmers (single)	30	3175284.172	1.00824E+13
	Integrated farmers (corn-cattle)	30	3908995.282	1.52802E+13
Statistical test				The income
Z. counting				7.53
Z. table (0,05)				1.96

Table 6.Partial Analysis of corn Farmers Non-integration and Integration of Cattle, 2018

Description	Corn farmers	Integrated farmer scorn–cattle
	Per Ha/season	Per Ha/season - Per Period
The Income		
Corn	Rp.14,654,849	Rp.17,823,640
Cow	-	Rp. 6,679,618
Total income	Rp.14,654,849	Rp.24,503,258
The cost		
Variable cost		
-Corn	Rp.8,835,333	Rp. 6,187,035
-Cow	-	Rp. 2,591,392
Fixed cost		
-Corn	Rp. 168,000	Rp. 168,000
-Cow	-	Rp. 203,325
Total cost	Rp. 9,003,333	Rp. 9,149,752
The income	Rp. 5,651,516	Rp. 15,353,506
R/C Ratio	1.62	2.68

In general, farmers work on their own land even though there are some who become farmers. Ownership of maize land and non-integration corn farmers' production were relatively unequal, from 30 respondents most farmers have a land area of 0.3-0.5 ha (40%) with an average production of 1885.42 kg and at least 10% on range of 1.2 - 1.4 ha with an average production of 3531.25 kg (Table 1). The dominant cattle ownership of dominant cattle was in 2-3 cattle, 63.33% of the total respondents (Table 2). While the ownership of maize land was most ranged from 1 to 1.4 ha (40%) with an average production of 5153.85 kg and at least 10% of the range 1.2 - 1.4 ha with an average production of 7500 kg. This indicates that corn crops are the highest demand by Bone Bolango communities. The ownership of corn crops farmer integration is more than the group of farmers who only cultivate corn. The high ownership of corn crops is due to the need for more corn waste to be used as cattle feed owned by farmers. The total population of cows in Bone Bolangoin 2017 was 28,350, up 2.29% from the previous year, with an average ownership of three heads per family. Farm-crop integration farmers generally do not have cattle pens for shade or cow dung. The method of cattle raise used grazing either in the dry or rainy season. Farmers set aside 1-2 hours a day to graze cattle. The corn harvest was usually sold to collecting traders on a wholesale basis with cash receipts in farmers' homes. However, there are some farmers whose crops are sold directly to maize-exporting factories (CV Harim Gorontalo)

Analysis of Revenue and Partial Differences Farming

Based on the results of the Z test of two different population averages in Table 3, it can be seen that the value of Z counting was 6.31, while Z table (0.05) was 1.96. So the value Z counting was greater than Z table (0.05), meaning H0 hypothesis is rejected. There is difference between corn farming income group of non-integration farmer and corn farmer income group of farmers of integration. Integration efforts undertaken by some Bone Bolango farmers significantly affect the income received by farmers. This can be seen that farmer-livestock groups have higher incomes for maize farming compared to non-integration corn farmers. This is due to the acceptance of corn production of integrated farmer groups increased by 22% compared to non-integration farmer groups. Due to the impact of fertilization where the farmer integration uses manure (organic) from cow dung for corn crops. According to Gil, Garrett, and Berger, (2016) and Gil, Siebold, and Berger, (2015) stated that integrated crop-livestock systems can increase the content of organic matter in soils that increase agricultural production. In addition, the cost of inorganic fertilizer use of farmer groups was lower (decreased by 30%) than non-integrated corn farmers who did not use cow manure (Table 4). Maize Farm and R/C Ratio of Farmer Integration Ratio was higher than non-integrated farmers which was11,468,605 IDR/ ha and R/C ratio 2.81. This means that every1 rupiah expenditure gave a receipt of 2.81 rupiah. Non-integration farmers only provide income of 5,651,516 IDR / ha and R / C ratio of 1.62. Each 1 rupiah of expenditure gave a receipt of 1.62 rupiah. The crop-livestock integration program can increase the productivity of crop-livestock farming which will ultimately lead to increased income and welfare of farmers and farm households (Handayani, 2009). The results of the Z test differ from the average of two populations in Table 5, it can be seen that the Z value is more greater than 7.53, while the Z table value (0.05) was 1.96. So the Z value of counting was greater than Z table (0,05), meaning H0 hypothesis is rejected, that is there is income difference between group of corn farmer non-integration and group of farmer corn-cow integration. Integration efforts undertaken by some Bone Bolango farmers significantly affect the income received by farmers. Crop-livestock farming groups are higher incomes than single farming groups (maize). In addition to the increased acceptance of maize production and the declining cost of using fertilizer (the impact of cow manure) on integration efforts, there is also an increase in income from farmers' cattle farms. The acceptance of cattle amounted to 6,679,618 IDR per person / period derived from the sale of livestock 6,170,000 IDR and compost sales processed from cattle waste 509,618 IDR. This is in line with Lemaire et al. (2013), that crop-livestock integration was able to increase the diversity of production output. The activities of crop-livestock integration systems provide benefits, such as increased production and income of farmers. Increased production occurs both in crops and livestock so that the income of farmers also increases. Increased farmers' income is not only due to the increase in the main production of crops and livestock, but also increased production of waste that can be processed and then sold so that farmers obtain additional revenue (Khairiah and Wasito, 2007 and Priyanti, 2007). While in terms of cost, especially labor, using family labor both on corn farmers and corn-cattle integration farmers so that the cost was calculated an opportunity cost of corn and livestock farming activities. Total cost for cattle was 2,794,717 IDR which provide net income 3,884,901 IDR and total revenue integration was 15,353,506 IDR. Based on the value of R/C ratio was obtained by each group in Table 6showing corn farmers have a value 1.62 which means that every 1 dollar expenditure yielded returns of 1.62 rupiah. Meanwhile, cattle-livestock integration farmers have a value of 2.68. This indicates that every 1 rupiah incurred in the farm will result in a return of 2.68 rupiah. Thus, the integration of livestock-crops by farmers is able to increase the cost value of return and higher than the return of corn farmers. This is in line with Bonaudo et al. statement. (2014), that crop-livestock integration can benefit farmers and the environment.

Conclusion

Characteristics of farming by integration farmers of Corn-cattle by Bone Bolango, Gorontalo significantly affect farm income. The values of R/C ratio of integrated corn farming are 2.81, 2.68 of corn-cattle integration management which is higher than non-integration corn 1.62. This means that crop-livestock integration undertaken by farmers is able to increase the value of cost and higher returns compared to the return of corn farmers. Thus integration of livestock is a concept of zero waste system that can provide benefits such as increase the productivity of crop-livestock farming, income and welfare of farmers and good for environmental sustainability.

Conflicts of Interests: All authors have none to declare.

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