Optimizing Farm Inputs of Maize Silage Production Integrated with Small Scale Dairy Farming

Hadiana, M.H[1]., Rivianda, A.D[1]., Suptraman,H[1]. and Suryadi.D[1].
[1]Department of Social and Economics of Livestock Development.
Padjadjaran University.
Corresponding email: hadiana.hasan@gmail.com

ABSTRACT

The study aim is to identify a model of smallholder dairy production that which the farmer could control feed resources and its supply in order minimizing feed risk for their cattle, as well as to identify the most efficient of using inputs (minimized cost) in producing the silage. The reseach is a case study on the farm activity. Farm record, such as farm output, inputs and their price, were collected and selected to meet the analysis requirement. Improving feeding system based on maize silage, in practice, can be adopted by the farmer who ccupy a hectare arable land. With doubled yielding in one plant season, the silage fulfils 40% of the daily forage requirement for feeding 7.6 animal unit of dairy cattle over a year regularly. The integrated farming system can be considered by the dairy farmer who attempts scaling up their farming within limited labor availability.

Keywords: Whole crop, Linear programming, Feeding system.

INTRODUCTION

Milk production is briefly a biological process of transforming farm input, particularly feed and water consumed by dairy cows to produce raw milk in a farm. Lands are the main resource for agriculture that tends to scarce due to the population growth and the increase of its demand by other sectors. Intensive livestock production will persist and continue to dominate in many countries, development for the future of livestock production is tend to either intensive, large-scale, technology based production; or small scale, alternative agriculture with livestock-crop integration. In tropical developing countries, livestock tends to be small scale and well integrated with crop production (Cheeke, 2004).

Maize silage usage for feed is a common practicing in industrial or large-scale dairy farming. The silage production method relies on heavy equipment, sizable land, and large production to meet the forage requirements for a plenty of cattle. Interest in the feeding of processed maize silage for lactating cows has increased, many studies showed that processing whole plant maize silage improves total tract-starch digestion and milk production by dairy cows (Bal *et al*. 2000). Silage is considered the better way to conserve forage crops (FAO, 2004). It can be produced and stored in various methods. The farmers obtain several advantages such as the planting period could be shortened so that their crop yields doubled, more stored feed, milk production increase in both volume and quality.

There is a little attention to study the possibility to improve cattle feeding system that could support small farmer. A quasi-experiment has been designed to examine the key issue on economic and technical factors that restrict producer to yield maize silage. The study concerned to small scale production of maize silage, the aims is to determine the optimum level of inputs usage, especially farm labor in all stage of production that minimized total

operating cost, the second is to identify farm resources required to develop the integrated farming system.

MATERIALS AND METHODS

This study based on three years observation and analysis to the farm records data of an integrated production activity that involve land cultivation to produce maize, crop processing, and cows milk production. The farm is located in Kecamatan Pamulihan, Sumedang Regency.

Linear Programming analysis was used to determine the optimal amount of farm inputs (as decision variables) that could minimize the cost of production (the farmers objective) with the subject to several constraints that presumed strictly linear. The technique is used in wide range of application, including agriculture, industry, behavioural and social science (Taha, 2003). Farm labor in this analysis is considered as the major decision variable, because the operating cost mostly is allocated for paying hired labor to undertake whole activities of growing crop and producing silage (Hadiana *at al*, 2016). Technically, labor usage (man day) significantly affects hybrids maize production (Purwanto *et al*, 2015).

This analysis used labor inputs as decision variables. Producers planed to allocate at least 811 man day. The objective is to minimize labor cost. The linear equation model that represent integrated activities are formulated to determine the value of the decision (amount of man day in each activity) as follow:

Labor for crop :	C_m	= skilled labor (man day)
	C_f	= unskill labor (man day)
Labor for silage production:	S_m	= skilled labor
	S_f	= unskill labor
Labor for dairying activities:	D_m	= skilled labor

The object of the farming system is to minimize operating cost, that is:
Minimize $Z = W_1 \mathbf{Cm} + W_2 \mathbf{Cf} + W_3 \mathbf{S_m} + W_4 \mathbf{S_f} + W_5 \mathbf{D_m}$.
$\mathbf{W_i}$ = wage rate of hired labor for the specific activity (IDR/man day)
The constraints of the problem include:
(1) The total men day, required for all activity for a year, either male or female, (2) Amount of labor requirement for crop, (3) Amount of skilled labor for crop, (4) Total workers day requirement for silage production, (5) Amount of labor for crop processing, (6) Total workers day requirement for refilling bag silage, (7) Amount of skill labor for maintenance, (8) Amount of labor requirement for dairying activities, and (9) Nonnegativity of the variable :$Cm \geq 0$; $Cf \geq 0$; $Sm \geq 0$; $Sf \geq 0$; $Dm \geq 0$.
The optimal solution for the formulated problem above was computed with using Solver Excell. Man day is used to measure of how much of work or labor is required to finish a job, a man day equivalent to man works during 7 hours. Wage rate used local labor rate for agriculture.

RESULTS AND DISCUSSION

Base on the schedule of farm activity within a year, the labor start to work in the early of the rainy months, that is in the first half of November. The land is prepared after its condition is sufficiently moist for planting. Entering to the fourth month, in February, the crop should have been harvested and carried to the barn to be processed. The farm budget is constructed on the basis of one hectare of land (Table 1) with two planting periods, it causes the producers should prepare fund twofold. The gross return or the value of the silage is listed first, assumed the silage is sold out at price IDR 1000 per kilogram. Labor is the main

resources, it shares 55.95% to the total variable cost (IDR 34.43 million). This input is used in both crop production and post harvest. The crop requires labor more intensive that causes the cost is relatively high, it reaches 31.05% of the total variable cost. The Labor is costly related to the length of time required for crop maintenance. On the other hand, producer strives to complete several activities shortly over the rainy season caused more hired labor required.

Table 1. The Operating Cost of Silage Production for a Hectare of Maize.

No	Operating inputs	1st half season	2nd half season	Total (one season) IDR million	%
A	GROSS RETURN				
	Total value maize silage			41.5	
B	CROP				
1	Land tax and rent			3.50	9.27
2	Labor:				30.78
	- Land preparation	2.10	0.40	2.50	
	- Spreed Manur	1.50	1.60	3.10	
	- Sowing seed	0.90	0.80	1.70	
	- Fertilizing	1.12	1.40	2.52	
	- Weeding	-	1.80	1.80	
3	Fertilizer:	-	-	-	
	- Nitrogen	0.99	0.83	1.82	4.82
	- NPK	0.39	0.70	1.09	2.89
4	Manure	1.20	1.25	2.45	6.49
5	Seed	0.65	0.63	1.28	3.39
C	POST HARVEST				
6	Labor:	-	-	-	17.54
	- Harvest	1.60	2.32	3.92	
	- Crop processing	1.44	1.08	2.52	
	- Preparing silo	0.12	0.06	0.18	
7	Fuel	0.20	0.16	0.36	0.95
8	Oil and repair	-	0.24	0.24	0.64
9	Spare part	0.20	0.77	0.97	2.57
10	Molases	0.15	0.30	0.45	1.19
11	rice bran	0.15	0.06	0.21	0.56
12	Plastic sheet	0.60	0.60	1.20	3.18
D	HANDLING SILAGE				
14	Labor:	-	-	-	10.01
	- Refilling silage bag	0.96	1.92	2.88	
	- Maintenance	0.45	0.45	0.90	
15	Plastic bag	0.86	1.30	2.16	5.72
	Total			37.75	100.00

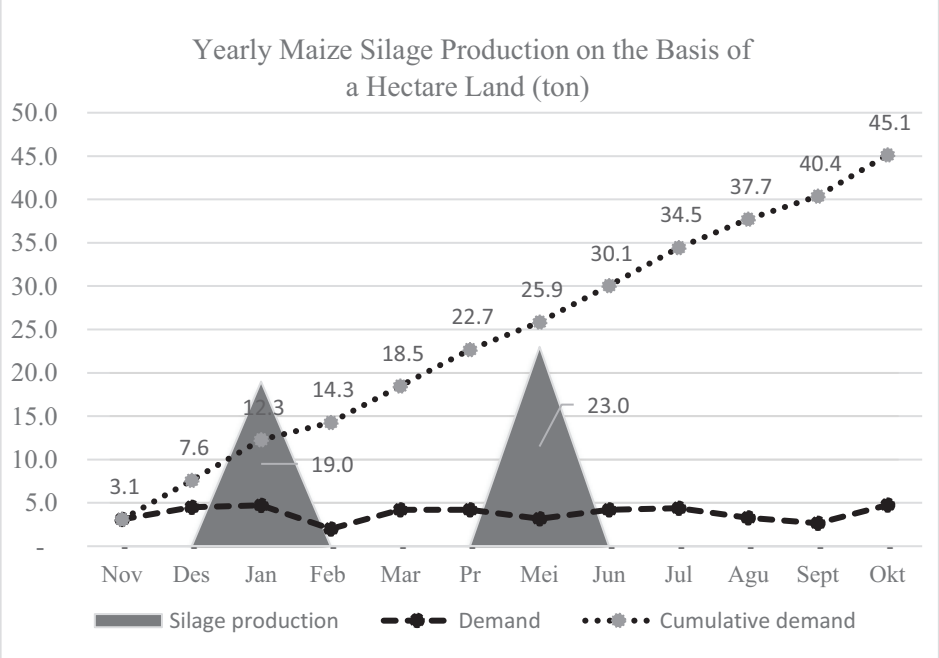
The second major inputs are fertilizer, the cost of both chemical fertilizer and manure share 14.3% to the total variable cost. Nitrogen is used as much 300 kg and NPK 150 kg, used a half in the first week after planting, and the remains are added in the sixth week. Manure as much 2 ton is applied a days before planting.

Optimalization of maize silage production

Optimization analysis of the farm's input problem, particularly in labor usage, identified that labor optimizing caused total labor cost decline 10.5%. The analysis results in the lowest total labor cost is IDR47.47 million. To reach the optimum solution, producers should be considered to reduce the labor used in some activities, especially in processing and post harvest activity.

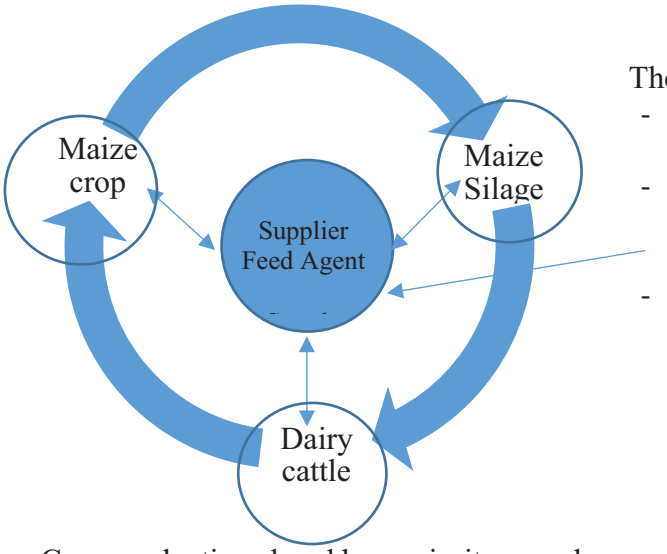
Labor used tends to high compared to some studies on hybrids maize farming as reported by Simorangkir *et al* (2014), and Purwanto *et al* (2015). Utilize animal manure before planting caused labor usage and production cost higher. The manure applies on average 2 tons for the first planting and 1-1.5 tons for the second. The manure utilization is necessary for the long run purposes by maintaining soil biological environment and greater organic fertilizer for soil (Cheeke, 2004).

. The crop is harvested in the fourth month after planting, or in the middle of January. Having been cut, the crop is carried to the barn to be processed (chopped) for silage. As much19-23ton of silage yielded from one period of planting, or on the average 41.5 tons silage per year. That amount is distributed following the feeding practice planned. On average 3.6 ton of silage per month is supplied to feed 7.6 animal unit is integrated to this purpose. This feeding is prepared to fulfil 40% daily requirement for forage.



Organizing farmers and resources

Small farmer mostly has limited farm resources particularly land for forage, a little possibility for the farmer individually to combine all stage of production within an integrated farming system. From market approach policy, developing a commodity can be approached with the supply-demand mechanism. Policies are created to make the market worked efficiently, anyone can enter the market freely as producer or consumer. The supply-demand movement and market price of the commodity is resulted in by producers and consumers decision (Ellis, 1992). From institution policy approach, the government could sponsored dairy cooperatives to take an initiative to develop the feeding services unit. The unit does not only assist dairy farmer but also construct a supply-chain that connect all production unit or agent.



The major tasks :

- facilitate the requirements for the three production unit.
- Sceduling the crop production or its availability, linked to silage demand and storage capacity
- Controling the crop quality, processing, storage, and silage delivery

· Crop production shoud be a priority agenda, successful maize silage production can be achieved by starting with high-yielding and well-adapted crops (Lee et al, 2005). The major objectives are should addressed to the dairy farm sector more productive. The sector should develop significantly on the basis of the business practices efficiency, economies of cattle size and milk production, as well as the farmer income. It would result in value chain impact for other economic agent involved in the integrated system.

CONCLUSIONS

Improving feeding system based on maize silage, in practice, can be adopted by the farmer who occupied a hectare arable land. With doubled yielding in one plant season, the silage fulfils 40% of the daily forage requirement for feeding 7.6 AU of dairy cattle over a year regularly. For optimization purpose, decisions should be made to reduce labor usage on post harvest and crop processing. The integrated farming system can be considered by the dairy farmer who attempts scaling up their business within limited labor availability. Based on these results, future research should emphasise on the crop for silage production by selecting high-yielding hybrid, as well as the appropriate technology for good producing silage practices.

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