Comparative analysis of cost on slurry application in Chile and Argentina dairy farms

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Abstract

Intensification of milk production systems in Argentina (AR) and Chile (CH), based on more inputs and new technologies, has caused an increase in the amount of slurry. The objective of this study was to evaluate slurry application costs and economical balance at dairy farm level, considering slurry nutrient contents in both countries. Benefit-cost analysis was carried out using information from 110 dairy farms in each country. Slurry dry matter content (SLDM%) presented significant differences between countries ($p<0.01$), with medium values of 0.62% for AR and 1.3% for CH. Low SLDM% brings low nutrient content, reducing its economic value. Considering a slurry application rate of 50 m^3 ha^{-1}, the 40% of CH and 99.2% of AR farms had a negative economical balance. Increasing 1% of SLDM represents 19.56 USD for AR and 44.79 USD for CH. While slurry application is a feasible cost efficient technology in Chilean dairies, strategies to improve water use efficiency on milking routine and slurry management in both countries.

Introduction

In the last years has been an intensification of South American dairy systems, being based in increasing use of technology, fertilizer and feeds. This has implied a high milk production but at the same time and increase of dairy slurry production. The efficient use of slurry on soil could reduce the use of inorganic fertilizer, which can be important on decrease cost for farmers. Dairy slurry has been used as organic fertilizer in many crop and pasture with positive effects from the agronomic point of view, however, there are only few studies published evaluating economical aspects, which is a key aspect for farmers. In Argentina and Chile dairy farms are based on grazing systems where animals are only partially housed. Main component of dairy slurry is water from cleaning milking facilities and rainwater, therefore, slurry dry matter content are very low (c.2-4%). Slurries are applied to soil mainly using irrigation pumps and slurry tank, however, there is no information on cost of this management practices and the slurry value. The objective of this study was to evaluate cost of slurry application and the economical balance considering the contribution of nutrients in slurry on dairy farms in Argentina and Chile.

Materials and methods

Benefit-cost analysis was carried out using information collected in 110 dairy farms, which were surveyed for each country and slurry sample collected. Dairy slurry was analyzed for dry matter content and total nitrogen (N), total phosphorus and total potassium, an informed as kilograms of N, P_2O_5 and K_2O for m^{-3} of slurry, respectively, which are the same nutrient form in inorganic fertilizers. Nutrient on slurries were valued indirectly from representative unitary market prices of mineral fertilizers of each country as urea, superphosphate and potassium chloride, respectively. National fertilizer data bases were used for fertilizer price in December, 2012. For Argentina K was not considered in the evaluation because this nutrient is not applied to soil on the dairy production area. The dairy slurry application cost to soil was considered taking into account an average out farm contractors: 2.05 $USDm^{-3}$ in Argentina; USD 2.09 USD m^{-3} for Chile. The cost includes all the equipment, hand labor and operational and financial cost for slurry application. Generally, the equipment used is a slurry agitator and tank spreader. The benefit equation is give by:

$$\pi\ (q_{\bar{N}}) = \ p.q\ (N,P,K) - c\ (q)$$

Where $\pi(q)$ is the benefit equation; p : is de vector of unitary market prices of mineral fertilizers, *q*: is the vector of nutrient content doses of slurry, $c(q)$: is the cost application function, that depend on volume of slurry (q). An economical balance was calculated for each farm considering the value of the slurry rate used (50 m^3 ha^{-1}) and the cost of its application to the field. A correlation was done between dry matter content of slurry and its economical balance (Figure 1). In addition, a sensitivity analysis was carried out in each country considering different scenarios: increasing up to 200 and 400% in slurry DM; 25 and 50% increase in fertilizer prices, and 50% decrease and 50% increase in application cost.

Results

Low, but statistically different *(P<0,01)* DM content of slurry was found on both countries: Md=1,3% for Chile and Md=0,62% for Argentina. The low DM content of slurries is directly related with a low content of nutrients and therefore its reduced economical value (Table 1). For Chilean dairy slurry a value of USD 2.81 m^{-3} slurry was determined. For Argentina, the value is lower due to its DM content and because K is not used for farmers, and therefore it was not considered in this evaluation. In both countries the mayor contribution to the slurry value is due to N, representing over 55% of the total estimated value of these nutrients in slurry. Economic evaluations, not presented in the present study, showed that the value of other macro and micronutrient present in slurry are very low, being N, P and K the most important. Considering a slurry application rate of 50 m^3 ha^{-1}, under the present conditions, 40% of Chile and 99.2% of Argentina dairy farms had a negative economical balance, which is due to the low DM and nutrient contents and therefore the economical value of slurry is not enough to match the application cost. A sensibility analysis showed that increasing the DM content 200% and 400% will have a positive effect, where 89.9% and 99% for Chile and 13.6% and 53.6% for Argentina farms will have a positive balance, respectively (Table 2). For Argentina, 1% slurry DM content increase represents 19.56 USD for each 50m^3 applied, for Chile it was equivalent to 44.79 USD (Figure 2). In addition, a 50% increase in the price of mineral fertilizers will have a positive effect on the economical balance of slurry, increasing to 7.2% and 77.8% of farms for Argentina and Chile, respectively. In the other hand, an increase in the application cost will have a negative effect on the economical balance for most of the farms, being greater in Argentina due to its low slurry DM content.

Conclusion and perspectives

Results from this study showed that slurry dry matter and nutrient contents are low in Chile and Argentina farms. This implied that economical value each m^3 is low (2.81 USD Chile and 0.5 USD Argentina) and that the balance between slurry value and application cost is negative in most of the Chilean (40.4%) and Argentinean farms (99.2%). An increase in DM content of slurry and/or price of inorganic fertilizer will increase the positive economical balance on dairy farms. This aspect is important for farmer to use more efficient slurry use on pasture and crops [1]. Research and technology transfer to farmer will be necessary to improve slurry management practices on dairy farms, where a reduction of clean and rainwater will be a key aspect to improve economical efficiency of slurry use [2]. However, changes in DM slurry contents could imply the use of different application techniques and therefore cost at farm level will need to be calculated. In addition, it is also important to take into account environmental aspects of the different management options.

References

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Table 1. Median economical value and nutrient contribution to the total estimated cost considering a slurry application rate of 50 m^{-3}.

	Nitrogen Value	Phosphorus Value	Potassium Value	Total Value
	(N)	(P_2O_5)	(K_2O)	(N, P, K)
Argentina (USD)	14.4	10.3		24.7
Chile (USD)	73.8	20.3	37.3	131.4
Argentina (%)	*58*	*42*		*100*
Chile (%)	*56*	*15*	*29*	*100*

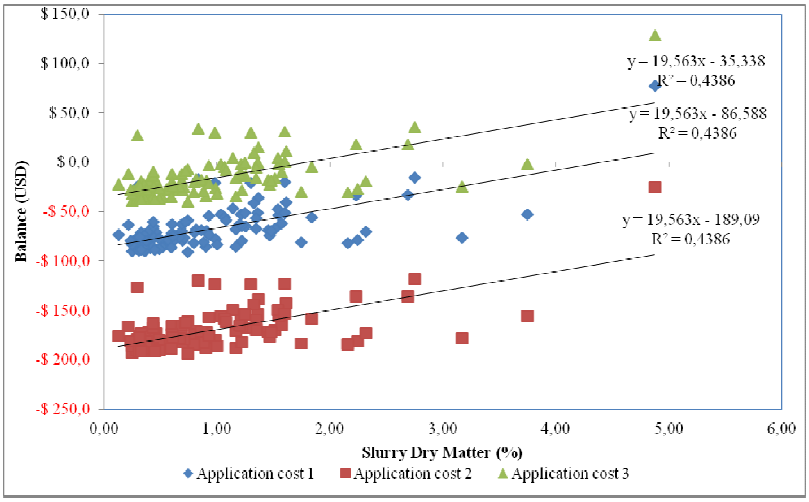

Figure 1. Sensitivity analysis on balance (slurry value-application cost) versus variation of application costs (0, +50 y -50% respectively) for Argentina.

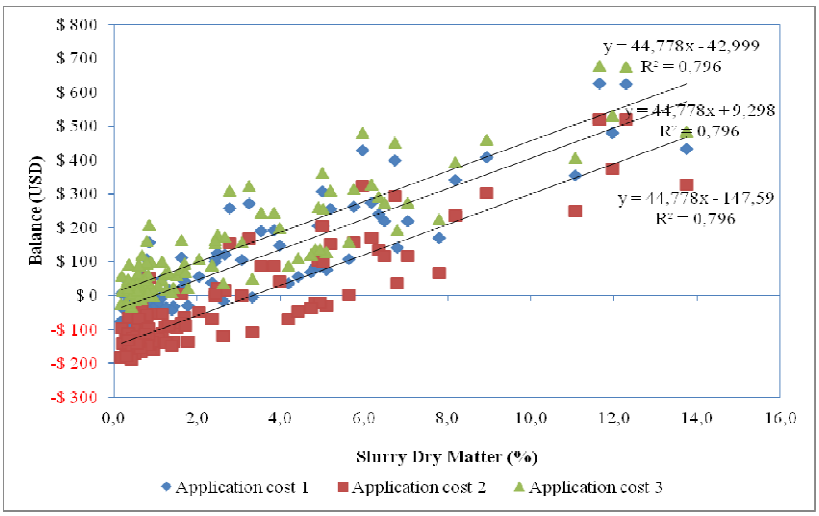

Figure 2. Sensitivity analysis on balance (slurry value-application cost) versus variation of application costs (0, +50 y -50% respectively) for Chile.

Table 2. Changes in the balance (slurry-application cost value) with different scenarios: % of study cases with positive balances.

	Argentina	Chile
Potential scenarios	**(% of Positive)**	**(% of Positive)**
Surveyed DM	0.8	59.6
Increase 200% of DM	13.6	89.9
Increase 400% of DM	53.6	99.0
Increase 25% of fertilizer price	3.2	67.7
Increase 50% of fertilizer price	7.2	77.8
Decrease 50% of application cost	13.6	89.9
Increase 50% of application cost	0	33.3