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Indicators of technological levels in milk production farms and impact on productivity of the factors

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Introduction

Milk production systems in Brazil are very heterogeneous regarding the use of production technology. In general, the technology used in a farm reflects both physical productivity of factors used and the economic results of the production process. In the case of physical productivity, three indicators may be used to compare the effect of the technological profile of differences between farms: animal productivity, labor productivity and the productivity of the land. Productivity gains are expected in these three indicators when intensifying production technology. The same should occur in a positive way with economic performance indicators. Otherwise, the technology is being applied properly in the productive process.
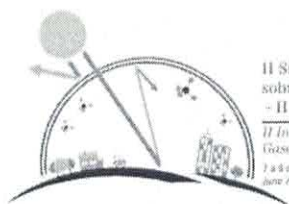
The present study aimed to evaluate the impact of technology of these indicators in milk-producing farms seeking to guide studies of mitigation of greenhouse gas emissions in dairy farming.

Material and Methods

To perform this study three typical farms of milk production was selected by extension workers of Emater/Paraná, specialists in dairy farms. The selection of the farms followed an approach known as Typical Farm Approach or Reference Production Systems (Hemme et al., 2015), methodology adopted by Embrapa to conduct socio-economic research on milk production farms (Stock & Carneiro, 2008; Stock et. al., 2008).

The farms are located in the Northwest of Paraná, in the municipality of São José da Boa Vista and represent three different technological profiles of dairy farms in that region: low, medium and high technology. Economics and technical coefficients was collect to represent each technology with the support of extension workers.

The estimation and analysis of costs and profitability of farms followed the standard methodology (Guiducci et al., 2012) adopted by the network of Pecus team. Three variables were chosen to indicate the technological level of the farms: area of land used for the dairy activity, amount of adult cows present in the herd and daily milk production. Two other indicators were chosen to represent the technological level: capital investment in the dairy activity and expenditure on feed concentrates. The productivity of the factors was indicated by the milk yield per cow, per acreage unit and per worker on the farm. The profitability indicators were the direct expenses per liter of milk produced and family income per acreage. The three farms were coded as S1, S2 and S3 according to the technological level represented respectively by low, medium and high.

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Results and Conclusions

By compering those farms with typical dairy farms in other Brazilian States (Minas Gerais and Goiás, for example) the farms are not considered large in terms of acreage. However, they are representative in terms of land use that prevails in the Southern of Brazil.

The milk production per farm is higher than the average of production observed in other regions of the country as well as the yield per cow. The farm selected to represent the low technology system (S1) had a yield per cow of 17.1 liters, which is also higher than the national average of 4.3 liters/day, in 2014. The indicator variables of productivity and profitability factors, in general, showed an expected consistency (table 1).

Table 1. Indicators of size, productivity of factors and profitability of farms representing three technological levels observed in the Northwest of the State of Paraná.

Indicator	Unit	Milk production system		
		S1	S2	S3
Area occupied with the dairy activity	ha	17.1	25.4	20.6
Milk production	L/day	365	1,570	1,250
Adult cows in the herd	Head	21	82	50
Total investment in the dairy activity	R$/ha	51,644.00	73,836.00	90,376.00
Expenditure on concentrated feed	R$/cow/year	2,186.00	2,585.00	3,559.00
Herd productivity	L/cow/day	17.4	19.1	25.0
Land productivity	L/ha/year	7,814	22,552	22,148
Labor productivity	L/worker/day	243	349	417
Costs per litter	R$/L	0.76	0.78	0.87
Family income	R$/ha	4,004.06	10,578.70	10,617.05

The increase of operating capital (variable "total investment in the dairy activity"), represented by investments in land, herd, machinery and equipment, agreed with the expansion of productivity, especially animal yield.

By analyzing the farms from low to high technologies, the variables investment and yield per cow clearly showed a trend in the same direction, i. e. the higher the investment in the dairy activity the higher the animal yield. Similarly, if considered the costs of feed (variable "expenditure on concentrated feed") as an indicator of technology and comparing with the animal productivity, a consistent path between the two variables is observed as well.

Labor productivity was another indicator consistently impacted by investment in the dairy activity and expenditure on concentrated feed. The productivity of land was similar in the farms of medium and high technologies (S2 and S3). However, by comparison both S1 and S2 with the low-tech farm (S1) it can be observed that the impact was significant and consistent in this productivity factor. The profitability indicators showed that medium-and high-tech farms produced more family income per acreage than the low-profile technological farm. On the other hand, the expenses were similar in the two farms of lower technology (S1 and S2), but higher in the S3 farm. This seems an expected behavior, considering the hypothesis that farms with higher technology are also those that present higher production scale (milk production in the case). However, they increase the total income from the farm to the extent that technological investments increase the scale of production. In this case, then, lower margin provides more total income resulting from the increased scale of production.
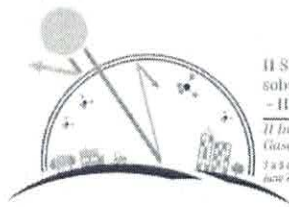
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This exploratory study found that stepping up technological indicators lined up with gains in productivity indicators and total profitability in milk-producing farms. The gain of scale, as expected, seems to be an important strategy to increase the total profitability of the dairy activity, although the net margin from each unit produced has been descending with technological intensification. Studies with a larger sample of farms with similar production system may confirm this statement.

For further research in this direction, other quantitative and qualitative indicators of technical and economic performance could be considered, making possible to use the data in simulations and complementary sensitivity analysis and greenhouse gas mitigation.

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