Economic and risk assessment of beef cattle production and different arrangements of integrated crop-livestock systems[I]

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Abstract: Soybean crops are expanding in areas traditionally used for livestock production in southern Brazil, which have led producers to decide to diversify or specialize their production. Thus, the aim of this study was to evaluate the economic returns and risk of the beef cattle production system and its integration with soybean production in different arrangements. Therefore, three production systems were simulated: beef cattle production (BP), beef cattle production associated with soybean leasing (BSL), and beef cattle production with soybean cultivation (BSC). By a stochastic model the variation of the gross margin per hectare (GM) and the risk of it being negative were evaluated. BSL presented the highest GM average (US $124.69 ± 22.81), followed by BSC (US $77.82 ± 59.53) and BP (US $69.54 ± 15.23). The BSC was the system with the highest difference between the maximum and minimum GM, besides being the only system to have probability of negative GM in 12.5% of simulations. The evaluation of beef cattle and soybean production separately in BSC showed that soybean had 37.1% of probability to negative GM, versus 100% of probability of positive GM in the beef cattle production. Thereby, the system BSL presented the greatest balance between risk and economic return, with higher GM than BP and lower risk than BSC.

Keywords: decision making, farming systems, beef cattle

Introduction

Soybean crops have expanded over areas traditionally used for livestock production in southern Brazil (Oliveira et al., 2017), mainly owing to the potentially high income provided by crops. These crops can be grown by the landowner or by another farmer, through land leases (Almeida and Buainain, 2016). However, the introduction of soybean crop in livestock systems can bring additional risks of economic losses (Russele et al., 2007), especially in regions of high risk for the culture. Therefore, the research aim was to perform an economic and risk analysis of beef cattle production and beef production integrated with soybean, whether through cropland leasing or cropping by the landowner, in southern Brazil.

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Material and Methods

The area analyzed was the southwest region of the Rio Grande do Sul state, in Brazil, a high risk zone for soybean crop (MAPA, 2019). Three full-cycle beef cattle production systems (cow-calf, yearling, and fattening) with or without soybean crop were simulated: beef cattle production only (BP), beef cattle production with soybean lease area (BSL), and beef cattle production with soybean cultivation (BSC). Each system operated in 1000 ha of total area, however, in BSC and BSL 250 ha were occupied by soybean during the summer, and by winter pasture (*Lolium multiflorum Lam.)* during the winter.

By stochastic modelling the gross margin per hectare (GM) and the risk of negative GM for each simulated system were evaluated. The model operated by the interaction of three sub-models: beef cattle production, soybean production, and economic. For the beef cattle production sub-model was used the model described by Lampert et al (2020). The soybean production sub-model used the region historical data of soybean productivity (EMBRAPA, 2015), and just BSC operated with this sub-model. The economic sub-model considered as input variables the historical data of production costs of beef cattle (CEPEA, 2014) and soybean production (FNP, 2015), as well the region price series payed for the beef cattle production (EMATER 2016), soybean production (CEPEA, 2016), and leasing.

Results and Discussion

The average GM of three systems was positive, and the highest was observed in BSL (US $124.69 ± 22.81), followed by BSC (US $77.82 ± 59.53), and BP (US $69.54 ± 15.23). The lowest diference between the minimum and maximum GM was observed in BP (US $21.25; US $155.97) and BSL (US $49.41; US $237.02), owing to less influence of high variability factors, such as selling prices and production costs, in the GM composition which reduced systemic risk (Ryschawy et al., 2012). The BSL added the benefits of crop-livestock integration, mirrored in the increase of livestock productivity (Moraes et al., 2014), to the revenue from leasing (Almeida and Buainain, 2016), allowing it to increases revenue at a low cost and low variation of GM outcomes.

The highest difference between maximum and minimum GM, occurred in BSC (US $754.12). Moreover, BSC was the only system which presented negative GM, in 12.5% of simulations due to the higher dependence of high variability factors, such as soybean price and soybean productivity (Bell and Moore, 2012), in the formation of GM. Furthermore, when the soybean production is evaluated separately from beef cattle production in BSC, the probability

of negative GM was 37.1%, while the probability of positive GM for beef cattle production was 100%. This demonstrated the capacity of livestock as systemic risk mitigation factor (Nunes et al., 2021).

Conclusion

The introduction of soybean crop into a livestock system increases GM variation, which ultimately increases systemic risk. However, leasing part of the total area to another farmer to cultivate can incorporate the benefits of integrated crop-livestock systems without all risks of the crop. Therefore, in a high-risk zone for soy crops, the association between beef cattle production and soybean leasing offers the best balance between risk mitigation and profit.

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