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ECONOMIC VIABILITY OF THE LOW CARBON BRAZILIAN BEEF UNDER MARKET RISKS

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ABSTRACT
The integrated crop-livestock systems (ICL) are alternatives to reduce GHG emissions, while increasing beef and crops production. In particular, the economic viability of new Low Carbon Brazilian Beef (LCBB) protocol remains to be proved for farmers to adopt it. The aim of this study was to analyze the economic viability of the LCBB protocol from an ICL system, under market risks, considering an alternative monetization for the protocol and various scenarios of input and output prices. A deterministic and a stochastic investment analysis was carried out using Monte Carlo simulation from @ Risk®, varying beef, soybean, urea and NPK fertilizer prices. ICL, with and without the LCBB protocol, was economically viable and presented very low market risks, given the past ten years of prices. In general, output prices were most influential on the Present Net Value. LCBB protocol improves the financial results, but implementation and running costs of the certification process must be cautiously established for the protocol to remain economically attractive to farmers.
Key words: Integrated Farming Systems; Investment analysis; Risk analysis

INTRODUCTION

The growing world demand for food, fibers and energy has created opportunities for the expansion of Brazilian agricultural products in the international market and, simultaneously, raised questions about their environmental impacts. Despite the undeniable evolution of beef productivity, with the introduction land-saving technologies, the beef sector has been challenged to adopt more sustainable production systems. Commitments made by Brazil after COP-21, under the Paris Agreement on Climate Change, demand the reduction of greenhouse gases (GHG) by 37% and 43% by 2025 and 2030, respectively; and beef is a relevant contributor to GHG.

The integrated crop-livestock systems (ICL) and, in particular, the recently launched initiative of the Low-Carbon Brazilian Beef protocol – LCBB buy Embrapa (details in ALMEIDA & ALVES, 2020), are alternatives to achieve these goals with government support, through the National Low Carbon Agriculture Plan (ABC Plan).

Despite the technical knowledge about ICL systems, the economic benefits, specially under uncertainties, remain overlooked (MARTHA JR. et al., 2011). Also, there is still definition of a LCBB bonus. The present study aims to analyze the economic viability of the LCBB protocol from an ICL system, under market risks, considering the monetization of the protocol and various scenarios of input and output prices.

MATERIAL AND METHODS

An experimental plot of six hectares with ICL, in Campo Grande-MS, Brazil, was implemented to test its capacity to recover degraded pasture in Savannah-like regions in Central Brazil, while mitigating GHG emissions by cattle. The production system comprised two consecutive cycles of four years (2008-2012 and 2012-2016): one of soybean followed by three of beef cattle. Detailed information on establishment practices is presented in Pereira et al. (2014). Soybean was cultivated

in November/08 and in November/12. After harvests, palisade grass (*Urochloa brizantha* cv. Piatã) was sown, and three Nellore heifers (160 kg) were introduced in the experimental plot. In the second cycle, pasture was fertilized annually with 111 kg ha^{-1} of urea and 200 to 300 kg ha^{-1} of 0-20-20 (Nitrogen-Phosphorous-Potassium).

For the economic analysis, an 8-year cash flow was prepared using 2020 average prices and exchange rate (1.0 BRL= 0.194 USD), and considered: Revenues (R), Operating costs (OC), including seeds, fertilizer, chemicals, freight and labor, and Net Benefits (NB). Beef operating costs were estimated at 0.28 USD/kg LWT [1], while the average price for females was 1.41 USD/kg LWT (adapted from CEPEA [2]). Soybean operating costs and production were USD 607.53 and 2,100 kg ha^{-1}, respectively, in cycle 1 and USD 591.18 and 2,916 kg ha^{-1}, respectively, in cycle 2. The R and OC were calculated considering only the meat produced within the experimental plot (453 kg ha^{-1} yr^{-1}, cycle 1; 502 kg ha^{-1} yr^{-1}, cycle 2) and associated costs. By doing this, we assumed the "farm" had a cow-calf operation providing the heifers for fattening. Third party contractors were used to account for labor and machinery costs (i.e., opportunity costs). An investment analysis was carried out and the present net value (PNV) and present net value annualized [3] (PNVa) for ICL, with and without the LCBB protocol, were calculated at an annual discount rate of 8.71%. This was considered the opportunity cost of capital represented by a five-year Pre-fixed Government Bond. The activity is considered economically attractive, if PNV>0. Since there was no negative NB, there was no need to calculate other investment parameters. Given the deterministic nature of the cash flow and the known volatility of commodities prices (MARTHA JR. et al., 2011; VINHOLIS, 2021), a risk analysis was conducted, using shocks on product prices (beef and soybean) and on major input prices (urea and NPK fertilizer) in a stochastic simulation model. The average beef, soybean, urea and NPK prices (random variables in the model) from 2010 to 2020 were obtained from CEPEA and Embrapa (based on paid access to livestock bulletins) and were used to estimate the variables probability distribution function (Triangular distribution, in this cases). All prices were deflated by the General Price Index – Internal availability (IGP-DI). The minimum and maximum prices were identified within each deflated time series, along with the most likely price, chosen as the 2020 value from the original cash flow, were used as parameters in the Monte Carlo analysis that followed. The simulation was carried out using @ Risk® from Palisade, which ran the cash flow1000 times (iterations), using different stochastic prices for each year and each random variable. The result shows the empirical probability distribution of the PNV, from which the risk associated with the economic performance of ICL can be assessed. Additionally, a histogram with PNV values frequency allows for the analysis of the probability distribution.

[1] Beef operating costs were based on a typical stocker beef farm, medium technology in Goiás state (IFAG, 2020) and includes feeding, medication, vaccines, labor, but excludes pasture establishment and maintenance which are accounted for separately in the cash flow.

[2] CEPEA historical beef prices are available at: https://www.cepea.esalq.usp.br/br/indicador/boi-gordo.aspx

[3] PNVa shows a fixed amount to be paid over *n* periods at a given interest rate, which will equal to the total PNV. It is equivalent to a constant annual income and can be calculated, using the PGTO formula from Excel.

RESULTS AND DISCUSSIONS

Deterministic results from the investment analysis showed the economic performance was highly attractive, given the high PNV, irrespective of the implementation of the LCBB protocol. PNV was USD 2,582.85 and USD 2,515.03 for ICL with and without the LCBB protocol, respectively, that is, a difference of USD 67.82 per hectare. As expected, ICL system with a LCBB implemented presented better economic results due to additional margins assured by the premium of 4% paid per "arroba"

(i.e., equivalent to15 kg of carcass weight). Analyzing the PNVa, the ICL system producing LCBB resulted in an annual income of USD 508.20 ha^{-1} while ICL without the LCBB protocol accrued USD 494.86 ha^{-1}, an additional USD 13.35. Given the real cost of LCBB accreditation process is still unknown, this additional amount could be interpreted as the roof, in addition to the costs already considered here (USD 2.27 ha^{-1} yr^{-1}) for certification to remain economically viable, although less attractive for farmers. Economies of scale must also be addressed in ICL, as CARRER (2020) points out. A a typical beef farm, according to IFAG (2020, based on CEPEA), has 1.170 ha on pasture, and, if we hypothesize that half can be converted to ICL, the total additional revenue from LCBB would be USD 7,809.75 yr^{-1}.

The distribution of frequencies of PNV is shown on Figure 1 (left) alongside the variables with the largest impacts on PNV (right). The results show there are 90% probability of PNV assuming a value between USD 1,368 and USD 2,140 per hectare, while the mean and the minimum were USD 1,736 and USD 1,109, respectively (Fig. 1). The mean PNVa was USD 342, while the minimum and the maximum were USD 218 and USD 487, respectively. The probability of the farmer getting more than USD 487 ha^{-1} or less than USD 218 is lower than 5%, indicating the ICL with LCBB protocol has low market risks. Figure 1 (righthand side) also shows that the beef price is, by far, the most influential variable in determining PNV results. Our findings corroborate other studies that demonstrated high economic performance of ICL and low risks (MARTHA JR. et al., 2011; VINHOLIS et al., 2020). Martha Jr. et al. (2011) draws attention to high demand for capital in ICL, when farmers need to buy feeders.

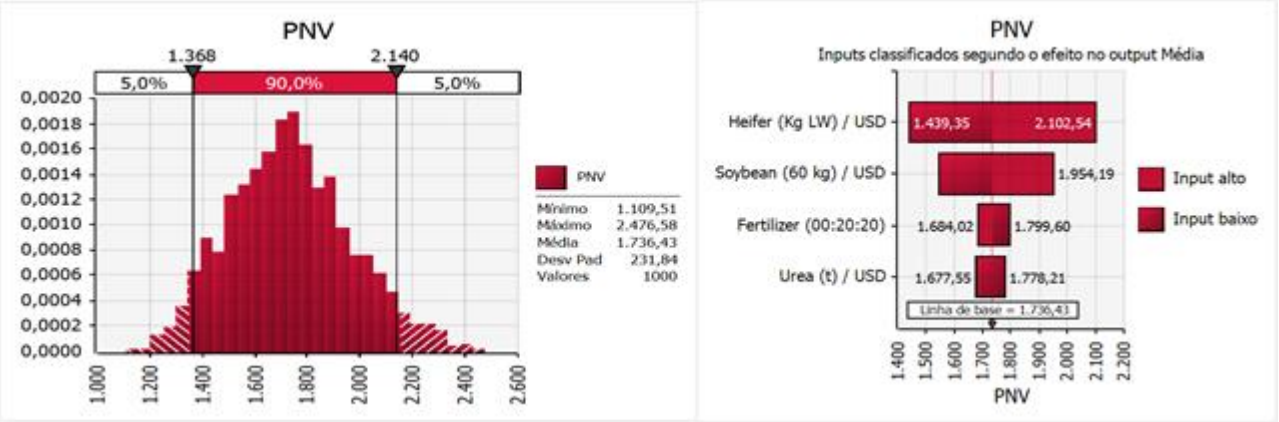

Figure 1. Frequency distribution of PNV for ICL with LCBB protocol (left) and effect of input and output prices on PNV (right).

CONCLUSIONS

Integrated Crop-Livestock systems are economically viable even in pessimist scenario of output and key input prices. LCBB protocol improves financial results, but implementation and running costs of the certification process must be cautiously established for the protocol to remain economically attractive to farmers.

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