

Title

Future perspectives of Brazilian beef production: What is the role of Silvopastoral systems?

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Supplementary material:

Table ST1: Beef production system characteristics

	CB	ICLFS	NR
Climate	Tropical moist	Tropical moist	Tropical moist
Soil type	LAC	LAC	LAC
Number of animals per production cycle	500	250/250	241/82
Type of animals	weaners (male)	weaners (male)	weaners (male/female)
Start age of finishing (days)	244	244	225
End age of finishing (days)	974	609/519	681
Start weight of finishing (kg)	180	210	210/190
End weight of finishing (kg)	540	516/550	540/510
Total duration of finishing (days)	730	365/275	456
Mortality (%)	1.5%	0.5%	1%
Feeding situations	100% pasture	85% pasture, 15% confined	80% pasture, 20% confined
Manure management systems	100% pasture/range/paddock	100% pasture/range/paddock	100% pasture/range/paddock

In ICLFS, two different finishing periods are managed in accordance with the available forage: group 1 starts in the dry season and is kept on pasture for 365 days. Group 2 starts in the rainy season and is transferred to confinement for 91 days after 182 days of grazing.

In NR, two different finishing groups are managed in accordance with the weaners coming from the farm's cow-calf production. Animals are separated by sex. A smaller group of female weaners is finished, due to the replacement need for the cow herd. Differences in weights (weaned and finished) are related to sex. Both groups are kept on pasture for 365 days and are then transferred to confinement for a further 91 days.

Table ST2: Feed rations

	CB	ICLFS	NR
		Strategy A	Strategy B
Roughages (pasture, shrubs)	97%	87%	53%
Silage (maize)			77%
Minerals (salt, supplements)	2%	1%	1%
Energy feed (corn, concentrates)	1%	12%	46%
Average digestibility	60%	63%	60%
Average protein content	7.8%	12.7%	10.1%

Feed characteristics are drawn from publicly available nutritional tables.

Table ST3: Upstream emission coefficients

Upstream emission source	CO ₂ equivalents per unit	Source
Fertilizer (NPK 08-28-16), per kg product	0.365	Derived from Brentrup et al. 2018
Corn per kg	0.41	FeedPrint, Version 2015.03
Minerals per kg	0.12	Cardoso 2012
Concentrate per kg	1.33	FeedPrint, Version 2015.03

No upstream emissions are considered for electricity use within the farm.

Sensitivity analysis of prices

Price variations were assessed for incoming animals (weaners from cow-calf production), concentrate price and beef price. Prices were derived from the CEPEA price data for the calendar years 2018 to 2023. Average prices per year were calculated. Price data show that 2021 was a high-price year, for weaners and maize, it shows the highest mean annual price of the selected years. Recently (2023) prices for all selected items dropped but had not reached pre-2021 levels (Figure SF1).

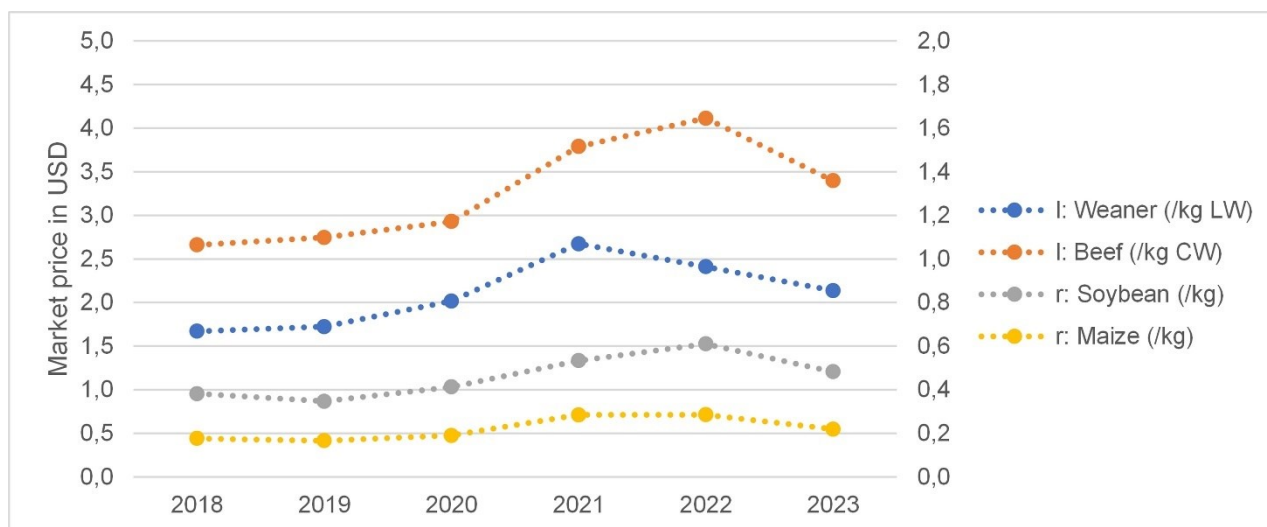


Figure SF1: Average prices for the years 2018 to 2023 of four selected key variables. Prices for weaners in USD per kg live weight (LW), prices for slaughter cattle in USD per kg carcass weight (CW), prices for soybean and maize in USD per kg.

To assess the impact of each variable separately for each system on the costs of production and profitability, we varied the 2021 price by the observed mean differences (Table ST4). As no price variation is available from the same database for concentrates, we assume a simplified composition of 50% soybean and 50% maize to vary the concentrate price.

Table ST4: Price data and variation in % of key variables

Variable	Unit	2021 level	Min	Max	Source	Price database
Beef price	per 15 kg CW	537,6	-0,30	0,09	CEPEA - Cattle	CEPEA/B3 Fed Cattle Price Index São Paulo State
Weaner price	per unit	56,8	-0,39	0,00	CEPEA - Calf	ESALQ/BM&FBOVE SPA Calf Price Index Mato Grosso do Sul State
Concentrate (50% maize, 50% corn)		24,5	-0,38	0,07	estimate based on a simplified 50:50 composition	
Maiz price	per 60 kg bag	32,0	-0,35	0,14	CEPEA - Corn	ESALQ/BM&FBOVE SPA Corn Price Index
Soybean price	per 60 kg bag	17,1	-0,41	0,00	CEPEA -Soybean	ESALQ/BM&FBOVE SPA Soybean Cash Price Index - Paranaguá (PR)

Cash costs represent 58% of the total costs for NR, 60% for ICLFS, and 65% for NR. With price levels of 2021, all systems were profitable in the short and medium term. With a variation in the costs of production and the beef price, we analyse whether this would also be the case if prices vary within a recently observed range (Figure SF2).

Under c.p. conditions, only assuming the observed 6-year minimum price for beef (“Beef - min” scenario), neither beef production system is profitable. CB is just below the threshold (-1 USD per 100 kg live weight added), but ICLFS and NR are even less profitable due to higher production costs. In the scenario “Weaner – min”, the order of profitability changes in favour of NR, although the share of animal purchase is similar in NR (72% of cahs costs) to CB (73%) (ICLFS: 59%). This highlights the comparatively higher animal productivity in NR. In this scenario, under c.p., the NR system is even profitable in the long term. In the scenario “Feed – min” the order of profitability changes in favour of ICLFS and NR, being more profitable in the short term than CB. This underlines the comparatively higher impact of feed costs in those two systems.

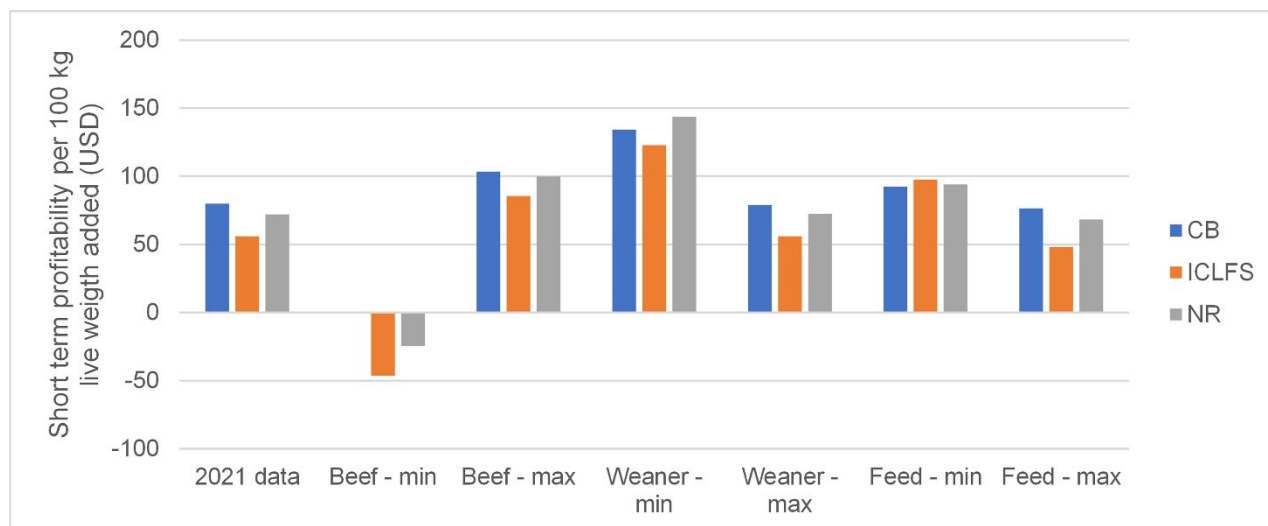


Figure SF2: Short-term profitability of the three beef production case studies for the analysed conditions (2021 data) and for variations in key prices (according to ST4)

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