

Supplementary Material

Forage accumulation and nutritive value in extensive, intensive, and integrated pasture-based beef cattle production systems

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Table S1. Meteorological data parameters and pastures irrigation by sprinkling water depths management (mm) in IP600 system during the experimental period (September 2019 to 2021).

Years	Months	Meteorological data					Eto – P mm	Sprinkler Irrigation mm
		Tmax °C	Tmin °C	RH %	Eto mm	P mm		
2019	SEPT	29.8	17.3	61.9	101.0	62.0	39.0	20.0
	OCT	31.3	17.9	63.6	127.7	65.2	62.5	72.5
	NOV	29.0	17.8	79.2	114.3	148.2	0.0	10.0
	DEC	28.5	18.9	82.7	108.6	196.0	0.0	6.7
2020	JAN	29.0	18.9	83.3	121.4	243.6	0.0	0.0
	FEB	27.2	18.7	90.3	88.3	370.2	0.0	0.0
	MAR	28.8	17.6	76.2	119.3	65.6	53.7	45.0
	APR	27.5	15.9	69.1	103.2	4.4	98.8	50.0
	MAY	24.6	13.4	64.1	84.3	23.2	61.1	72.0
	JUNE	25.7	15.3	70.6	74.8	29.2	45.6	44.0
	JUL	26.5	14.3	57.5	89.7	1.4	88.3	45.0
	AUG	26.6	14.0	55.8	94.1	16.6	77.5	63.0
	SEPT	31.3	19.7	43.0	113.1	34.2	78.9	64.0
	OCT	30.6	18.1	61.6	110.9	62.2	48.7	53.0
	NOV	29.7	16.3	66.4	135.4	116.6	18.8	32.0
	DEC	27.8	18.4	84.9	115.5	287.4	0.0	11.0
2021	JAN	29.4	19.4	80.5	128.2	122.2	6.0	22.0
	FEB	28.9	18.3	79.1	107.7	121.2	0.0	29.0
	MAR	28.9	18.5	72.1	114.1	158.7	0.0	12.1
	APR	27.2	16.3	69.1	103.8	13.3	90.5	73.6
	MAY	26.3	14.9	63.8	83.1	21.2	61.9	40.0
	JUNE	24.7	13.5	69.0	73.4	40.0	33.4	53.0
	JUL	24.6	11.2	49.5	85.2	11.0	74.2	71.0
	AUG	28.0	14.7	52.2	93.7	3.0	90.7	77.0
	SEPT	32.2	17.9	50.0	104.7	4.4	100.3	91.0
Average		28.2	16.7	67.8	1297.8	1110.5	-	-
Sum		-	-	-	2595.5	2221.0	1129.9	1056.9

Tmax, Maximum temperature. Tmin, Minimum temperature. RH, Relative humidity. Eto, Reference evapotranspiration. P, Rainfall. Eto – P, Accumulation of the difference between evapotranspiration and rainfall.

Table S2. Chemical soil characteristics at different levels of intensification of pasture-based beef cattle production systems (DP0, SP200, RP200, RP400 and IP600), in the 0-20 cm layer in 2019, 2020 and 2021.

Treatments	pH	pH	O. M.	P	K ⁺	Ca ²⁺	Mg ²⁺	Al ³⁺	H+Al	AS	EVN	V	m
	(H ₂ O)	(CaCl ₂)	(g dm ⁻³)	(mg dm ⁻³)	(mmol _c dm ⁻³)				(mmol _c dm ⁻³)		(%)		
2019													
DP0	5.4 ^{Bc}	4.8 ^{Bc}	21.0 ^{Cc}	4.0 ^{Cc}	1.2 ^B	17.5 ^{Bc}	7.5 ^{Bc}	1.0 ^{Aa}	37.5 ^{Aa}	26.0 ^{Bc}	63.5 ^{Abc}	41.0 ^B	5.5 ^{Aa}
SP200	6.0 ^{Bb}	5.2 ^{Bb}	20.3 ^{Cc}	6.9 ^{Cc}	1.5 ^B	24.2 ^{Bbc}	11.8 ^{Bbc}	0.4 ^{Ab}	21.7 ^{Ab}	37.3 ^{Bbc}	58.9 ^{Bc}	63.8 ^B	1.4 ^{Ab}
RP200	6.6 ^{Ba}	5.9 ^{Ba}	40.5 ^{Ca}	13.5 ^{Ca}	1.9 ^B	46.0 ^{Aa}	23.0 ^{Aa}	0.0 ^{Ac}	25.0 ^{Ab}	71.0 ^{Aa}	96.0 ^{Aa}	73.5 ^B	0.0 ^{Ab}
RP400	6.1 ^{Bab}	5.4 ^{Bb}	27.5 ^{Cb}	7.5 ^{Cbc}	1.5 ^B	26.0 ^{Bbc}	13.5 ^{Bbc}	0.0 ^{Ac}	25.5 ^{Ab}	41.0 ^{Bbc}	66.5 ^{Bbc}	61.0 ^B	0.0 ^{Ab}
IP600	6.3 ^{Bab}	5.6 ^{Bab}	24.5 ^{Cbc}	11.5 ^{Cab}	2.0 ^B	34.0 ^{Aab}	17.5 ^{ABab}	0.0 ^{Ac}	26.0 ^{Ab}	53.5 ^{ABab}	79.5 ^{ABab}	66.0 ^B	0.0 ^{Ab}
2020													
DP0	6.0 ^A	5.3 ^{Ac}	32.5 ^{Bc}	7.5 ^B	2.7 ^A	32.0 ^{Ab}	16.5 ^{Ab}	0.0 ^B	25.0 ^B	51.5 ^{Ab}	76.5 ^{Ab}	65.0 ^A	0.0 ^B
SP200	6.8 ^A	6.1 ^{Aab}	29.5 ^{Bc}	12.5 ^B	1.4 ^A	47.5 ^{Aa}	22.5 ^{Aab}	0.0 ^B	16.0 ^B	71.0 ^{Aab}	87.5 ^{Aab}	82.0 ^A	0.0 ^A
RP200	7.0 ^A	6.2 ^{Aab}	52.0 ^{Ba}	21.5 ^B	5.5 ^A	46.0 ^{Aab}	22.0 ^{Aab}	0.0 ^A	17.5 ^B	73.5 ^{Aab}	91.0 ^{Aab}	81.0 ^A	0.0 ^A
RP400	7.1 ^A	6.4 ^{Aa}	37.5 ^{Bb}	11.5 ^B	3.3 ^A	55.5 ^{Aa}	25.5 ^{Aa}	0.0 ^A	17.0 ^B	84.0 ^{Aa}	101.0 ^{Aa}	83.5 ^A	0.0 ^A
IP600	6.3 ^A	5.6 ^{Abc}	31.0 ^{Bc}	13.5 ^B	3.9 ^A	44.0 ^{Aab}	23.0 ^{Aab}	0.0 ^A	22.5 ^B	71.0 ^{Aab}	93.5 ^{Aab}	75.5 ^A	0.0 ^A
2021													
DP0	5.7 ^{Bb}	4.9 ^{Bb}	40.5 ^{Abc}	5.5 ^A	2.6 ^A	21.0 ^{ABb}	11.0 ^{ABb}	0.0 ^B	36.0 ^{Aa}	34.5 ^{ABb}	70.5 ^{Ab}	49.5 ^{Bb}	0.0 ^B
SP200	6.3 ^{Bab}	5.6 ^{Ba}	34.0 ^{Ac}	17.0 ^A	3.9 ^A	47.0 ^{Aa}	23.0 ^{Aa}	0.0 ^B	21.0 ^{Ac}	74.0 ^{Aa}	95.0 ^{Aa}	78.0 ^{Ba}	0.0 ^A
RP200	6.8 ^{Ba}	6.1 ^{Ba}	65.0 ^{Aa}	15.5 ^A	4.7 ^A	52.5 ^{Aa}	25.5 ^{Aa}	0.0 ^A	22.0 ^{Ac}	82.5 ^{Aa}	104.5 ^{Aa}	78.5 ^{Ba}	0.0 ^A
RP400	6.6 ^{Ba}	5.7 ^{Ba}	49.0 ^{Ab}	18.5 ^A	6.0 ^A	51.0 ^{Aa}	26.5 ^{Aa}	0.0 ^A	25.0 ^{Abc}	83.5 ^{Aa}	108.5 ^{Aa}	77.0 ^{Ba}	0.0 ^A
IP600	5.7 ^{Bb}	5.1 ^{Bb}	37.5 ^{Abc}	20.0 ^A	4.0 ^A	24.0 ^{Bb}	13.0 ^{Bb}	0.0 ^A	30.5 ^{Aab}	41.0 ^{Bb}	71.5 ^{Bb}	56.5 ^{Bb}	0.0 ^A

Means followed by capital letters indicate differences in years and lowercase letters differences in treatments by Fisher's test (p<0.05).

Treatments: DP0: extensively managed rainfed degraded *Urochloa* spp. pasture. SP200: intensively managed silvopastoral system with rainfed *U. decumbens* cv. Basilisk and Brazilian native trees receiving 200 kg N ha⁻¹ year⁻¹. RP200: intensively managed rainfed *Urochloa* spp. pasture with 200 kg N ha⁻¹ year⁻¹. RP400: intensively managed rainfed *Megathyrsus maximus* cv. Tanzânia with 400 kg N ha⁻¹ year⁻¹. IP600: intensively managed and irrigated *M. maximus* cv. Tanzânia pasture with 600 kg N ha⁻¹ year⁻¹, overseeded in the dry season with oat and annual ryegrass.

Table S3. Chemical soil characteristics at different levels of intensification of pasture-based beef cattle production systems (DP0, SP200, RP200, RP400 and IP600), in the 0-20 cm layer in 2019, 2020 and 2021.

Treatments	S.SO ₄	B	Cu	Fe	Mn	Zn
	(mg dm ⁻³)					
2019						
DP0	13.0 ^{Aab}	0.27 ^{Bb}	1.7 ^{Ac}	62.5 ^{Aa}	1.3 ^{Bc}	1.4 ^{Ab}
SP200	8.3 ^{Ac}	0.29 ^{Bab}	1.0 ^{Ac}	48.3 ^{Ab}	1.8 ^{Bc}	0.8 ^{Ab}
RP200	14.5 ^{Aa}	0.42 ^{ABab}	13.0 ^{Aa}	26.0 ^{Bc}	40.4 ^{Aa}	1.9 ^{Ab}
RP400	10.5 ^{Ab}	0.47 ^{ABa}	5.6 ^{Ab}	14.5 ^{Bd}	22.9 ^{Ab}	7.4 ^{Aa}
IP600	14.5 ^{Aa}	0.35 ^{Aab}	2.4 ^{Abc}	32.0 ^{Ac}	1.2 ^{Bc}	2.7 ^{Ab}
2020						
DP0	6.5 ^{Bb}	0.58 ^{Aa}	1.6 ^A	25.0 ^B	7.9 ^A	1.9 ^A
SP200	8.5 ^{Ab}	0.41 ^{ABab}	1.5 ^A	25.0 ^B	5.7 ^A	1.6 ^A
RP200	7.0 ^{Bb}	0.51 ^{Aab}	2.1 ^B	22.0 ^B	5.6 ^B	1.3 ^A
RP400	11.5 ^{Aa}	0.51 ^{Aab}	1.9 ^A	22.5 ^B	4.3 ^B	1.3 ^B
IP600	8.5 ^{Bb}	0.37 ^{Ab}	2.0 ^A	29.5 ^A	5.3 ^{AB}	1.4 ^A
2021						
DP0	8.0 ^{Bc}	0.41 ^{Aab}	1.7 ^A	28.0 ^{Bc}	10.0 ^{Aa}	1.1 ^A
SP200	9.0 ^{Ac}	0.49 ^{Aa}	2.6 ^A	31.0 ^{Bbc}	4.6 ^{ABb}	2.1 ^A
RP200	16.0 ^{Aa}	0.28 ^{Bb}	4.3 ^B	40.0 ^{Aab}	3.9 ^{Bb}	2.3 ^A
RP400	12.5 ^{Aab}	0.32 ^{Bab}	2.8 ^A	44.0 ^{Aa}	4.3 ^{Bb}	2.8 ^B
IP600	10.0 ^{Bbc}	0.34 ^{Aab}	1.9 ^A	29.0 ^{Ac}	6.5 ^{Aab}	1.2 ^A

Means followed by capital letters indicate differences in years and lowercase letters differences in treatments by Fisher's test ($p < 0.05$).

Treatments: DP0: extensively managed rainfed degraded *Urochloa* spp. pasture. SP200: intensively managed silvopastoral system with rainfed *U. decumbens* cv. Basilisk and Brazilian native trees receiving 200 kg N ha⁻¹ year⁻¹. RP200: intensively managed rainfed *Urochloa* spp. pasture with 200 kg N ha⁻¹ year⁻¹. RP400: intensively managed rainfed *Megathyrsus maximus* cv. Tanzânia with 400 kg N ha⁻¹ year⁻¹. IP600: intensively managed and irrigated *M. maximus* cv. Tanzânia pasture with 600 kg N ha⁻¹ year⁻¹, overseeded in the dry season with oat and annual ryegrass.

Table S4. Chemical soil characteristics at different levels of intensification of pasture-based beef cattle production systems (DP0, SP200, RP200, RP400 and IP600), in the 20-40 cm layer in 2019, 2020 and 2021.

Treatments	pH	pH	O. M.	P	K ⁺	Ca ²⁺	Mg ²⁺	Al ³⁺	H+Al	AS	EVN	V	m
	(H ₂ O)	(CaCl ₂)	(g dm ⁻³)	(mg dm ⁻³)	(mmol _c dm ⁻³)				(mmol _c dm ⁻³)		(%)		
2019													
DP0	5.3 ^{Bc}	4.7 ^{Cb}	13.5 ^{Cc}	2.5 ^{Aa}	1.0 ^B	15.5 ^{Bc}	6.5 ^{Bc}	2.5 ^{Aa}	38.5 ^A	23.0 ^{Bc}	61.5 ^{Ab}	37.5 ^{Cb}	10.0 ^{Aa}
SP200	5.7 ^{Bb}	5.0 ^{Cb}	11.8 ^{Cc}	3.1 ^{Ba}	1.0 ^B	18.7 ^{Bbc}	8.7 ^{Bbc}	1.3 ^{Ab}	25.2 ^A	28.4 ^{Bbc}	53.5 ^{Bb}	53.9 ^{Cab}	4.9 ^{Ab}
RP200	6.4 ^{Ba}	5.7 ^{Ca}	32.0 ^{Ca}	6.0 ^{ABa}	1.3 ^B	39.0 ^{Aa}	17.5 ^{Aa}	0.0 ^{Ac}	24.5 ^A	57.5 ^{Aa}	82.0 ^{Aa}	70.5 ^{Ca}	0.0 ^{Ac}
RP400	6.1 ^{Bab}	5.4 ^{Ca}	25.0 ^{Cb}	5.5 ^{Ba}	1.2 ^B	22.5 ^{Bbc}	10.0 ^{Bbc}	0.0 ^{Ac}	23.0 ^A	33.5 ^{Bbc}	56.5 ^{Bb}	59.0 ^{Ca}	0.0 ^{Ac}
IP600	6.2 ^{Ba}	5.4 ^{Ca}	15.5 ^{Cc}	4.0 ^{Ba}	1.2 ^B	28.5 ^{Bab}	13.5 ^{ABab}	0.0 ^{Ac}	23.0 ^A	43.0 ^{Bab}	66.0 ^{Bb}	65.0 ^{Ca}	0.0 ^{Ac}
2020													
DP0	5.9 ^{Ac}	5.2 ^{Ab}	24.0 ^{Bbc}	4.5 ^A	1.9 ^A	29.5 ^{Ab}	13.0 ^{Ab}	0.0 ^B	23.5 ^B	44.5 ^{Ab}	68.0 ^{Ab}	62.5 ^A	0.0 ^B
SP200	6.5 ^{Aabc}	5.8 ^{Aab}	22.0 ^{Bc}	7.0 ^A	1.8 ^A	42.5 ^{Aa}	20.5 ^{Aa}	0.0 ^B	16.5 ^B	64.5 ^{Aa}	81.5 ^{Aab}	79.5 ^A	0.0 ^B
RP200	7.2 ^{Aa}	6.3 ^{Aa}	35.0 ^{Ba}	5.0 ^B	3.4 ^A	40.0 ^{Aab}	19.0 ^{Aa}	0.0 ^A	18.5 ^B	62.5 ^{Aab}	81.0 ^{Aab}	77.0 ^A	0.0 ^A
RP400	7.1 ^{Aab}	6.4 ^{Aa}	29.5 ^{Bab}	3.0 ^B	2.0 ^A	47.5 ^{Aa}	20.0 ^{Aa}	0.0 ^A	16.0 ^B	69.5 ^{Aa}	85.5 ^{Aa}	81.0 ^A	0.0 ^A
IP600	6.3 ^{Abc}	5.7 ^{Aab}	24.0 ^{Bbc}	7.0 ^A	3.5 ^A	40.5 ^{Aab}	17.5 ^{Aab}	0.0 ^A	20.5 ^B	61.5 ^{Aab}	82.0 ^{Aab}	75.0 ^A	0.0 ^A
2021													
DP0	5.7 ^B	5.2 ^{Bbc}	29.5 ^A	2.5 ^{Ac}	1.8 ^{Ac}	18.5 ^{Bb}	8.5 ^{ABc}	0.0 ^B	32.0 ^A	28.5 ^{ABb}	60.5 ^{Ab}	47.5 ^{Bc}	0.0 ^B
SP200	5.9 ^B	5.3 ^{Bbc}	27.0 ^A	6.5 ^{ABbc}	2.6 ^{Abc}	23.0 ^{Bb}	10.5 ^{Bc}	0.0 ^B	24.5 ^A	36.0 ^{Bb}	60.5 ^{Bb}	59.5 ^{Bbc}	0.0 ^B
RP200	7.0 ^B	6.2 ^{Ba}	42.5 ^A	9.5 ^{Ab}	3.5 ^{Ab}	40.0 ^{Aa}	16.5 ^{Aab}	0.0 ^A	21.5 ^A	60.0 ^{Aa}	81.0 ^{Aa}	74.0 ^{Bab}	0.0 ^A
RP400	6.7 ^B	5.9 ^{Bab}	38.5 ^A	15.5 ^{Aa}	4.6 ^{Aa}	44.5 ^{Aa}	19.0 ^{Aa}	0.0 ^A	20.5 ^A	68.0 ^{Aa}	88.5 ^{Aa}	77.0 ^{Ba}	0.0 ^A
IP600	5.8 ^B	5.1 ^{Bc}	30.5 ^A	9.5 ^{Ab}	2.8 ^{Abc}	24.0 ^{Bb}	11.0 ^{Bbc}	0.0 ^A	25.0 ^A	37.5 ^{Bb}	62.5 ^{Bb}	66.6 ^{Babc}	0.0 ^A

Means followed by capital letters indicate differences in years and lowercase letters differences in treatments by Fisher's test (p<0.05).

Treatments: DP0: extensively managed rainfed degraded *Urochloa* spp. pasture. SP200: intensively managed silvopastoral system with rainfed *U. decumbens* cv. Basilisk and Brazilian native trees receiving 200 kg N ha⁻¹ year⁻¹. RP200: intensively managed rainfed *Urochloa* spp. pasture with 200 kg N ha⁻¹ year⁻¹. RP400: intensively managed rainfed *Megathyrus maximus* cv. Tanzânia with 400 kg N ha⁻¹ year⁻¹. IP600: intensively managed and irrigated *M. maximus* cv. Tanzânia pasture with 600 kg N ha⁻¹ year⁻¹, overseeded in the dry season with oat and annual ryegrass.

Table S5. Chemical soil characteristics at different levels of intensification of pasture-based beef cattle production systems (DP0, SP200, RP200, RP400 and IP600), in the 20-40 cm layer in 2019, 2020 and 2021.

Treatments	S.SO ₄	B	Cu	Fe	Mn	Zn
	(mg dm ⁻³)					
2019						
DP0	16.0 ^{AB}	0.20 ^{Cb}	1.3 ^{Ac}	22.5 ^{Aab}	1.1 ^{Cc}	0.4
SP200	14.8 ^{AB}	0.21 ^{Bb}	1.0 ^{Ac}	27.4 ^{Aa}	0.8 ^{Bc}	0.4
RP200	22.0 ^{AB}	0.29 ^{Bab}	12.6 ^{Aa}	18.5 ^{ABbc}	28.4 ^{Aa}	0.9
RP400	14.5 ^{AB}	0.36 ^{Aa}	5.5 ^{Ab}	11.0 ^{Bd}	15.4 ^{Ab}	2.1
IP600	19.0 ^{AB}	0.21 ^{Ab}	2.9 ^{Abc}	16.5 ^{Bcd}	0.7 ^{Bc}	1.2
2020						
DP0	9.5 ^B	0.55 ^{Aa}	1.3 ^A	19.0 ^{Aab}	5.0 ^B	1.3
SP200	17.5 ^B	0.37 ^{Abc}	1.2 ^A	16.0 ^{Bb}	3.8 ^A	1.2
RP200	13.0 ^B	0.43 ^{Ab}	1.3 ^B	16.5 ^{Bb}	4.1 ^B	1.0
RP400	14.5 ^B	0.32 ^{Ac}	1.2 ^B	16.5 ^{Bb}	3.3 ^B	1.0
IP600	15.5 ^B	0.30 ^{Ac}	1.4 ^A	23.0 ^{Aa}	4.0 ^A	1.0
2021						
DP0	15.0 ^A	0.31 ^B	1.4 ^A	19.5 ^{Ab}	7.9 ^{Aa}	0.7
SP200	18.0 ^A	0.30 ^{AB}	1.8 ^A	24.5 ^{Aab}	2.9 ^{ABb}	1.5
RP200	26.0 ^A	0.23 ^B	2.9 ^B	24.0 ^{Aab}	2.4 ^{Bb}	1.1
RP400	18.0 ^A	0.28 ^A	2.5 ^{AB}	27.0 ^{Aa}	3.1 ^{Bb}	1.5
IP600	19.5 ^A	0.28 ^A	1.2 ^A	19.0 ^{ABb}	3.8 ^{Ab}	0.7

Means followed by capital letters indicate differences in years and lowercase letters differences in treatments by Fisher's test ($p < 0.05$).

Treatments: DP0: extensively managed rainfed degraded *Urochloa* spp. pasture. SP200: intensively managed silvopastoral system with rainfed *U. decumbens* cv. Basilisk and Brazilian native trees receiving 200 kg N ha⁻¹ year⁻¹. RP200: intensively managed rainfed *Urochloa* spp. pasture with 200 kg N ha⁻¹ year⁻¹. RP400: intensively managed rainfed *Megathyrsus maximus* cv. Tanzânia with 400 kg N ha⁻¹ year⁻¹. IP600: intensively managed and irrigated *M. maximus* cv. Tanzânia pasture with 600 kg N ha⁻¹ year⁻¹, overseeded in the dry season with oat and annual ryegrass.

Table S6. Leaf area traits and morphologic characteristics of C₄ grasses pastures at different levels of intensification of pasture-based systems (DP0, SP200, RP200, RP400 and IP600) during the experimental period.

Effects		Variables				
Treatments	Seasons	LAI	SLA	Leaf	Stem	Dead Material
		(m ² m ⁻²)	(cm ² g ⁻¹)	(%)	(%)	(%)
C ₄ Grasses						
DP0		0.61	138.6	27.9	16.7	55.4
SP200		1.16	223.5	23.2	23.5	53.3
RP200		2.13	175.0	27.1	32.2	40.7
RP400		3.92	115.0	47.5	28.5	24.0
IP600		6.57	138.9	54.1	26.2	19.7
	Spring	2.68	149.9	52.8	14.7	32.5
	Summer	4.92	189.3	48.5	38	13.5
	Autumn	2.55	162.4	27.3	31.9	40.8
	Winter	1.35	132.0	16.1	16.9	67
Means		2.67	156.8	36.1	25.4	38.5
Standard Error		0.21	4.06	1.26	1.23	1.46
Statistical Probabilities (P Value)						
Treatments		<.0001	<.0001	<.0001	<.0001	<.0001
Seasons		<.0001	<.0001	<.0001	<.0001	<.0001
Treatments × Seasons		<.0001	0.0002	<.0001	<.0001	<.0001

LAI: Leaf area index; SLA: Specific leaf area.

Treatments: DP0: extensively managed rainfed degraded *Urochloa* spp. pasture. SP200: intensively managed silvopastoral system with rainfed *U. decumbens* cv. Basilisk and Brazilian native trees receiving 200 kg N ha⁻¹ year⁻¹. RP200: intensively managed rainfed *Urochloa* spp. pasture with 200 kg N ha⁻¹ year⁻¹. RP400: intensively managed rainfed *Megathyrus maximus* cv. Tanzânia with 400 kg N ha⁻¹ year⁻¹. IP600: intensively managed and irrigated *M. maximus* cv. Tanzânia pasture with 600 kg N ha⁻¹ year⁻¹, overseeded in the dry season with oat and annual ryegrass.

Table S7. Treatments × seasons interaction on the leaf area and morphologic characteristics of C4 grasses pastures at different levels of intensification of pastoral systems for beef cattle production (DP0, SP200, RP200, RP400 and IP600).

Treatments	Seasons			
	Spring	Summer	Autumn	Winter
Leaf Area Index (m ² m ⁻²)				
DP0	0.60 ^{Dbc}	1.06 ^{Da}	0.61 ^{Db}	0.15 ^{Cc}
SP200	1.38 ^{CDab}	2.17 ^{Da}	0.82 ^{Db}	0.25 ^{Cc}
RP200	1.75 ^{Cb}	3.49 ^{Ca}	2.44 ^{Cb}	0.85 ^{Bc}
RP400	3.49 ^{Bb}	7.64 ^{Ba}	3.53 ^{Bb}	1.01 ^{Bc}
IP600	6.20 ^{Ab}	10.21 ^{Aa}	5.35 ^{Ab}	4.52 ^{Ac}
Specific Leaf Area (cm ² g ⁻¹)				
DP0	135.84 ^{BCab}	150.99 ^{Ca}	148.51 ^{Ca}	119.12 ^{Cb}
SP200	197.18 ^{Abc}	299.35 ^{Aa}	218.39 ^{Ab}	179.25 ^{Ac}
RP200	157.40 ^{Bb}	211.24 ^{Ba}	186.65 ^{Ba}	144.85 ^{Bb}
RP400	126.20 ^{Ca}	136.28 ^{Ca}	111.28 ^{Da}	89.98 ^{Db}
IP600	132.91 ^{Cab}	148.84 ^{Ca}	147.09 ^{Ca}	126.78 ^{Cb}
Leaf (%)				
DP0	43.3 ^{Ca}	39.1 ^{Ca}	20.6 ^{BCb}	8.8 ^{Cc}
SP200	36.6 ^{CDa}	34.8 ^{Ca}	17.2 ^{Cb}	5.3 ^{Cc}
RP200	29.7 ^{Dab}	35.9 ^{Ca}	26.2 ^{Bb}	16.9 ^{Bc}
RP400	69.7 ^{Ba}	70.2 ^{Aa}	36.8 ^{Ab}	12.2 ^{BCc}
IP600	82.7 ^{Aa}	60.3 ^{Bb}	35.8 ^{Ac}	37.6 ^{Ac}
Stem (%)				
DP0	12.5 ^{ABb}	38.9 ^{BCa}	12.2 ^{Db}	3.0 ^{Cc}
SP200	20.0 ^{Ab}	44.7 ^{ABa}	23.8 ^{Cb}	5.2 ^{Cc}
RP200	20.7 ^{Ac}	49.0 ^{Aa}	37.7 ^{Bb}	21.2 ^{Bc}
RP400	9.8 ^{Bc}	26.6 ^{Db}	40.8 ^{ABa}	36.5 ^{Aa}
IP600	9.7 ^{Bd}	31.8 ^{CDb}	45.0 ^{Aa}	18.3 ^{Bc}
Dead Material (%)				
DP0	44.2 ^{Ac}	22.0 ^{Ad}	67.2 ^{Ab}	88.2 ^{Aa}
SP200	43.4 ^{Ac}	20.5 ^{Ad}	59.0 ^{Bb}	89.5 ^{Aa}
RP200	49.6 ^{Ab}	15.1 ^{ABd}	36.1 ^{Cc}	61.9 ^{Ba}
RP400	20.5 ^{Bb}	3.2 ^{Cc}	22.4 ^{Db}	51.3 ^{Ca}
IP600	7.6 ^{Cc}	7.9 ^{BCc}	19.2 ^{Db}	44.1 ^{Ca}

Means followed by the same capital letter in the column and lower case in the row do not differ by Fisher's test ($P < 0.05$).

Treatments: DP0: extensively managed rainfed degraded *Urochloa* spp. pasture. SP200: intensively managed silvopastoral system with rainfed *U. decumbens* cv. Basilisk and Brazilian native trees receiving 200 kg N ha⁻¹ year⁻¹. RP200: intensively managed rainfed *Urochloa* spp. pasture with 200 kg N ha⁻¹ year⁻¹. RP400: intensively managed rainfed *Megathyrsus maximus* cv. Tanzânia with 400 kg N ha⁻¹ year⁻¹. IP600: intensively managed and irrigated *M. maximus* cv. Tanzânia pasture with 600 kg N ha⁻¹ year⁻¹, overseeded in the dry season with oat and annual ryegrass.

Table S8. Treatments × seasons interaction on the productive characteristics of C₄ grasses pastures at different levels of intensification of pastoral systems for beef cattle production (DP0, SP200, RP200, RP400 and IP600).

Treatments	Seasons			
	Spring	Summer	Autumn	Winter
Seasons Accumulation of Forage Mass (kg DM ha ⁻¹ seasons ⁻¹)				
DP0	1996.3	3002.4	1915.3	1151.4
SP200	3143.9	4168.5	1610.8	1275.5
RP200	3386.6	6853.9	3243.6	1326.6
RP400	7321.1	11548.0	5749.2	3704.9
IP600	8820.9	11672.0	5871.1	4568.2
Daily Accumulation of Forage Mass (kg DM ha ⁻¹ day ⁻¹)				
DP0	21.9	33.0	21.0	12.7
SP200	34.5	45.7	17.7	14.0
RP200	37.2	75.3	35.6	14.6
RP400	80.5	127.7	63.2	40.7
IP600	96.9	128.3	64.5	50.2

Means followed by the same capital letter in the column and lower case in the row do not differ by Fisher's test (P<0.05).

Treatments: DP0: extensively managed rainfed degraded *Urochloa* spp. pasture. SP200: intensively managed silvopastoral system with rainfed *U. decumbens* cv. Basilisk and Brazilian native trees receiving 200 kg N ha⁻¹ year⁻¹. RP200: intensively managed rainfed *Urochloa* spp. pasture with 200 kg N ha⁻¹ year⁻¹. RP400: intensively managed rainfed *Megathyrsus maximus* cv. Tanzânia with 400 kg N ha⁻¹ year⁻¹. IP600: intensively managed and irrigated *M. maximus* cv. Tanzânia pasture with 600 kg N ha⁻¹ year⁻¹, overseeded in the dry season with oat and annual ryegrass.

Table S9. Nutritional characteristics of C₄ grasses pastures at different levels of intensification of pasture-based systems (DP0, SP200, RP200, RP400 and IP600) during the experimental period.

Effects		Variables		
Treatments	Seasons	CP (%)	NDF (%)	IVDMD (%)
C ₄ Grasses				
DP0		5.8	73.4	45.5
SP200		7.3	72.2	52.1
RP200		7.9	70.9	55.5
RP400		6.4	70.0	54.8
IP600		9.7	68.6	56.8
	Spring	8.9	69.6	55.4
	Summer	9.2	69.5	58.5
	Autumn	6.9	71.2	51.0
	Winter	4.7	73.7	46.8
Means		7.4	71.0	52.9
Standard Error		0.32	0.39	0.88
Statistical Probabilities (P Value)				
Treatments		0.0013	<.0001	0.0013
Seasons		<.0001	<.0001	<.0001
Treatments × Seasons		0.0003	0.0389	0.0002

CP: Crude protein; NDF: Neuter detergent in fiber; IVDMD: *In vitro* dry matter digestibility.

Treatments: DP0: extensively managed rainfed degraded *Urochloa* spp. pasture. SP200: intensively managed silvopastoral system with rainfed *U. decumbens* cv. Basilisk and Brazilian native trees receiving 200 kg N ha⁻¹ year⁻¹. RP200: intensively managed rainfed *Urochloa* spp. pasture with 200 kg N ha⁻¹ year⁻¹. RP400: intensively managed rainfed *Megathyrus maximus* cv. Tanzânia with 400 kg N ha⁻¹ year⁻¹. IP600: intensively managed and irrigated *M. maximus* cv. Tanzânia pasture with 600 kg N ha⁻¹ year⁻¹, overseeded in the dry season with oat and annual ryegrass.

Table S10. Treatments × seasons interaction on the nutritional characteristics of C₄ grasses pastures at different levels of intensification of pastoral systems for beef cattle production (DP0, SP200, RP200, RP400 and IP600).

Treatments	Seasons			
	Spring	Summer	Autumn	Winter
Crude Protein (%)				
DP0	7.9 ^{Ba}	6.0 ^{Bb}	5.0 ^{Cbc}	4.4 ^{Bc}
SP200	8.4 ^{Bb}	10.8 ^{Aa}	6.8 ^{Bc}	3.3 ^{Bd}
RP200	7.2 ^{Bbc}	9.7 ^{Aa}	8.2 ^{Aab}	6.4 ^{Ac}
RP400	8.0 ^{Ba}	9.3 ^{Aa}	5.7 ^{BCb}	2.5 ^{Bc}
IP600	12.9 ^{Aa}	10.1 ^{Ab}	8.8 ^{Ab}	6.9 ^{Ac}
Neutral Detergent Fiber (%)				
DP0	69.5 ^{ABb}	75.5 ^{Aa}	74.0 ^{Aa}	74.6 ^{ABa}
SP200	70.3 ^{Abc}	68.7 ^{Bc}	72.7 ^{Ab}	77.0 ^{Aa}
RP200	71.6 ^{Aab}	70.0 ^{Bab}	69.8 ^{Bb}	72.2 ^{Ba}
RP400	70.0 ^{ABbc}	66.6 ^{Bc}	70.3 ^{Bb}	73.0 ^{Ba}
IP600	66.6 ^{Bb}	66.9 ^{Bb}	69.9 ^{Bb}	71.5 ^{Ba}
Lignin (%)				
DP0	5.1	5.3	6.3	7.4
SP200	5.1	4.7	6.5	7.1
RP200	4.7	3.8	4.5	4.8
RP400	4.3	4.5	4.6	4.9
IP600	3.8	4.2	4.1	4.5
<i>In Vitro</i> Dry Matter Digestibility (%)				
DP0	50.3 ^{Ba}	52.8 ^{Ba}	42.2 ^{Cb}	36.8 ^{Dc}
SP200	58.2 ^{ABa}	62.4 ^{Aa}	47.8 ^{Bb}	40.1 ^{Cc}
RP200	52.8 ^{ABbc}	63.6 ^{Aa}	55.6 ^{Ab}	49.8 ^{Bc}
RP400	56.7 ^{ABa}	56.8 ^{ABa}	54.2 ^{Aa}	51.6 ^{Ba}
IP600	59.3 ^{Aa}	57.0 ^{ABa}	55.2 ^{Aa}	55.6 ^{Aa}

Means followed by the same capital letter in the column and lower case in the row do not differ by Fisher's test ($P < 0.05$).

Treatments: DP0: extensively managed rainfed degraded *Urochloa* spp. pasture. SP200: intensively managed silvopastoral system with rainfed *U. decumbens* cv. Basilisk and Brazilian native trees receiving 200 kg N ha⁻¹ year⁻¹. RP200: intensively managed rainfed *Urochloa* spp. pasture with 200 kg N ha⁻¹ year⁻¹. RP400: intensively managed rainfed *Megathyrus maximus* cv. Tanzânia with 400 kg N ha⁻¹ year⁻¹. IP600: intensively managed and irrigated *M. maximus* cv. Tanzânia pasture with 600 kg N ha⁻¹ year⁻¹, overseeded in the dry season with oat and annual ryegrass.

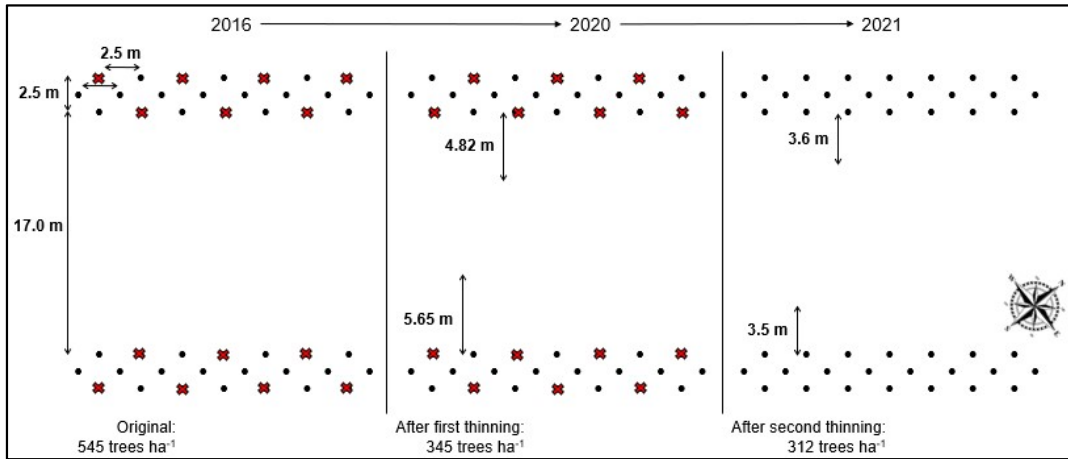


Fig. S1. Representative sketch of the shadow projection of the tree crowns of SP200 system with rainfed *U. decumbens* cv. Basilisk pasture and Brazilian native trees.