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Reassessment of the potential economic impact of cattle parasites in Brazil

Reavaliação do potencial impacto econômico de parasitos de bovinos no Brasil

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Abstract

The profitability of livestock activities can be diminished significantly by the effects of parasites. Economic losses caused by cattle parasites in Brazil were estimated on an annual basis, considering the total number of animals at risk and the potential detrimental effects of parasitism on cattle productivity. Estimates in U.S. dollars (USD) were based on reported yield losses among untreated animals and reflected some of the effects of parasitic diseases. Relevant parasites that affect cattle productivity in Brazil, and their economic impact in USD billions include: gastrointestinal nematodes - $7.11; cattle tick (*Rhipicephalus* (*Boophilus*) *microplus*) - $3.24; horn fly (*Haematobia irritans*) - $2.56; cattle grub (*Dermatobia hominis*) - $0.38; New World screwworm fly (*Cochliomyia hominivorax*) - $0.34; and stable fly (*Stomoxys calcitrans*) - $0.34. The combined annual economic loss due to internal and external parasites of cattle in Brazil considered here was estimated to be at least USD 13.96 billion. These findings are discussed in the context of methodologies and research that are required in order to improve the accuracy of these economic impact assessments. This information needs to be taken into consideration when developing sustainable policies for mitigating the impact of parasitism on the profitability of Brazilian cattle producers.

Keywords: Cattle parasites, production loss, economic assessment.

Resumo

A rentabilidade da atividade pecuária pode ser diminuída significativamente pelos efeitos dos parasitos que afetam o gado. As perdas econômicas causadas pelos parasitos dos bovinos no Brasil foram estimadas em uma base anual, considerando-se o número total de animais em risco e os efeitos negativos do parasitismo sobre a produtividade do gado. Estimativas em dólares baseiam-se em perdas de rendimento conhecidas em animais não tratados, e refletem alguns dos efeitos de doenças parasitárias. Aqui, tais perdas são referidas como perdas potenciais. Parasitos relevantes que afetam o bem-estar do gado e a produtividade no Brasil e seu impacto econômico em dólares incluem: nematódeos gastrintestinais - $7,11 bilhões; carrapato bovino (*Rhipicephalus* (*Boophilus*) *microplus*) - $3,24 bilhões; mosca-dos-chifres (*Haematobia irritans*) - $2,56 bilhões; berne (*Dermatobia hominis*) - $0,38 bilhões; mosca-da-bicheira (*Cochliomyia hominivorax*) - $0,34 bilhões; e a mosca-dos-estábulos (*Stomoxys calcitrans*) - $0,34 bilhões. A perda econômica anual combinada devido aos parasitos internos e externos dos bovinos aqui listados foi estimada em pelo menos $13,96 bilhões. Tais resultados são discutidos no contexto de metodologias e pesquisas necessárias, como a que envolve os efeitos da resistência aos parasiticidas de uso veterinário, para melhorar a precisão de tais avaliações de impacto econômico. Essa informação deve ser considerada pelos tomadores de decisão para influenciar programas de investigação e regulação, a fim de desenvolver políticas sustentáveis que reduzam o impacto do parasitismo sobre a rentabilidade dos pecuaristas brasileiros.

Palavras-chave: Parasitose bovina, perda na produção, danos por parasitos.

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In 2002, Grisi et al. made an attempt to assess the economic impact of cattle parasitism in Brazil. The resulting study was regarded as an important source of data on the economic drag that endo and ectoparasites inflict on cattle, especially from the producer's point of view. More than 10 years later, a lot has changed in the Brazilian livestock scenario: new data regarding production losses due to parasites have become available from many regions of the country. Hence, there was a need for an update.

Occurrences of internal and external parasites in cattle throughout Brazil are favored by the predominance of tropical and subtropical climates. The national cattle herd is estimated to comprise 212,797,824 heads, distributed over 8 million square kilometers of land (IBGE, 2011).

The economic impact of external parasites on cattle is mostly associated with infestations by the cattle tick, *Rhipicephalus* (*Boophilus*) *microplus*, horn fly (*Haematobia irritans*), cattle grub (*Dermatobia hominis*) and New World screwworm (*Cochliomyia hominivorax*). Furthermore, the importance of the stable fly (*Stomoxys calcitrans*) has increased over the last few years because of outbreaks associated with postharvest residues of the sugarcane industry (BARROS et al., 2010a). Other ectoparasites, such as the cattle mange and sucking and chewing lice, are seasonal and limited to the southern regions.

Drummond et al. (1981) estimated the annual losses due to cattle parasites to be $2,260 million in the United States, not including the costs of parasite control. This figure represented 10% of the value of production and sales at the time. The annual loss estimates for specific pests ranged from $29.7 million for scabies and mange mites to $730.3 million for horn flies. The cattle population in the USA in 1981 was estimated to be 124.7 million (NASS; USDA, 2011).

Grisi et al. (2002) estimated that the total economic losses due to ectoparasites in cattle in Brazil were $2,650 million. At that time, economic losses relating to the most important ectoparasite, the cattle tick, were based in a previous estimate by Horn (1983) of $968 million for a national cattle herd of 76 million head.

The potential economic losses due to cattle parasitism in Brazil caused by major ectoparasite species and gastrointestinal nematodes are evaluated here. Estimates of the potential economic losses of each parasite species or group are based on numbers of animals at risk and on the available data on losses in milk production and weight gain of beef cattle. Most of the data are from local studies; when such information is unavailable, estimates are based on selected studies conducted elsewhere. Because information regarding production losses was obtained from control animals (animals kept untreated in the respective studies), the resulting estimates of economic losses represent potential losses among untreated cattle. Thus, the estimates presented do not necessarily represent the actual impact of cattle parasitism in Brazil but the potential losses expected in the absence of parasite control measures.

The impact of gastrointestinal nematodes on cattle production has been extensively studied worldwide. Lima and Grisi (1984) assessed the milk production of cows medicated with albendazole at parturition in the state of Rio de Janeiro in comparison with controls, and reported an increase of 51.90 kg of milk per cow in the medicated group during the 90-day study period, which corresponded to 0.58 kg of milk/cow/day. Ploeger et al. (1989) conducted a similar study in Holland and reported an increase of 0.44 kg of milk/cow/day. Charlier et al. (2009) summarized the data prior to 1997 from studies on the impact of subclinical gastrointestinal parasitism in dairy cattle, and showed that medication produced an increase of 0.4 to 0.8 kg of milk/cow/day. Considering an average loss of 0.6 kg of milk per cow per day without medication, the potential losses of the dairy cattle population at risk due to gastrointestinal worms in Brazil would be $1,870.48 million (Table 1).

Based on 6 years of field trials with weaned Nelore cattle on improved pastures in central-western Brazil, Bianchin et al. (1995) showed that there was a superior average weight gain of 41 kg when the animals were dewormed following a strategic program. Likewise, studies conducted by Pinheiro (1983) showed that there was a difference of 67 kg in weight gain per animal between treated and untreated groups in the southern region. Analysis on data relating to beef cattle yearlings and heifers up to 2 years old showed that the potential losses due to helminth parasitism amounted to $5,237.49 million. Because of control problems commonly observed in the field, the potentially high losses due to gastrointestinal nematodes in dairy and beef cattle, estimated as $7,107.97 million (Table 1), strongly suggest that this parasitism represents the most important economic problem due to parasites in the country.

The damage to milk production caused by cattle ticks was recently evaluated by Rodrigues and Leite (2013) in the state of Minas Gerais, where 24.2% of the country's dairy cows are concentrated. These authors estimated that ticks were responsible for a reduction of 90.24 L in milk production per cow per lactation, which, when extrapolated to the national dairy herd, amounted to about $922.36 million of losses to the national dairy herd. Estimates of the losses inflicted by cattle tick on beef cattle were based on Jonsson (2006), who reported daily losses of 1.18 and 1.37 grams per tick per animal for *Bos indicus* x *Bos taurus* cattle and *B. taurus*, respectively. Average tick infestations were obtained from Smith et al. (2000) for *B. taurus* (94 ticks/animal) and Gomes et al. (1989) for *B. indicus* (3.3 ticks/animal) and crossbreeds (32 ticks/animal). Considering the whole Brazilian beef cattle herd (about 11% *B. taurus* and 89% *B. indicus* and crossbreeds), the potential economic losses caused by this tick on beef cattle were estimated to be $2,313.99 million. Therefore, the total economic loss attributable to *R.* (*B*) *microplus* in the Brazilian cattle herd may approach $3,236.35 million (Table 2).

Losses due to horn fly infestation were based on the studies of Bianchin and Alves (2002) and Bianchin et al. (2004), which estimated average yearly weight losses of 3.25 kg per cow, 2.00 kg per calf and 12.19 kg per steer (value also used for heifers). Considering populations at risk, as well as current market values, the total losses due to horn fly parasitism in Brazil approach $2,558.32 million (Table 3). Although infestations by the horn fly and the closely related buffalo fly (*H. irritans exigua*) may reduce milk production (JONSSON; MAYER, 1999), the relatively low infestations usually observed on dairy cattle, probably due to frequent cattle tick treatments, suggest that the impact of horn flies may be not so evident in Brazil. No estimate of horn fly losses on dairy cattle or beef cattle pregnancy rates is provided here, since these subjects need further investigation.

Table 1. Economic losses due to gastrointestinal nematodes among dairy and beef cattle in Brazil, in 2011.

	Population at risk	Milk loss	Yearly milk loss*	Total herd yearly loss**	Price to producer	Potential loss for dairy cattle
	(million head)	(kilogram /cow/ day)	(kilogram/cow)	(millions of liters)	(US$/liter)	(millions of US$)
Dairy cattle	23.23	0.60	183.00	4,251.09	0.44	1,870.48
	IBGE (2011)	Charlier et al. (2009)			CEPEA (2013a, b, c)	

*Considering a 305-day lactation period. **1 kg of milk = 0.971 liters of milk.

	Population at risk***	Yearly weight loss	Affected herd yearly loss	Price to producer	Potential loss	Potential loss for beef cattle
	(million head)	(kilogram/ head)	(millions of kilograms)	(US$/kilogram)	(millions of US$)	(millions of US$)
Beef cattle (northern, north-eastern and central-western regions)	47.74	41.00	1,957.34	1.62	3,170.89	
		Bianchin et al. (1995)				5,237.49
Beef cattle (southern and southeastern regions)	19.04	67.00	1,275.68		2,066.60	
		Pinheiro (1983)		CEPEA (2013a, b, c)		
					Total potential loss	**7,107.97**

*** Considering only yearlings, and heifers up to 2 years old. Based on IBGE (2011) and Anualpec (INFORMA ECONOMICS FNP, 2013).

Table 2. Economic losses due to the cattle tick, *Rhipicephalus* (*Boophilus*) *microplus*, relating to milk and beef production in Brazil, in 2011.

	Population at risk	Lactation loss	Yearly milk loss	Price to producer	Potential loss
	(million head)	(liter)	(millions of liters)	(US$/liter)	(millions of US$)
Dairy cattle	23.23	90.24	2,096.28	0.44	922.36
	IBGE (2011)	Rodrigues and Leite (2013)		CEPEA (2013a, b, c)	
Beef cattle	**Population at risk**** (million head)**	**Daily weight loss (grams/tick/head)**	**Yearly weight loss* (millions of kilograms)**	**Price to producer (US$/kilogram)**	**Potential loss (millions of US$)**
B. taurus	20.85	1.37	980.05		1,587.68
		Jonsson (2006)			
B. indicus x B. taurus	16.87	1.18	232.51	1.62	376.67
		Jonsson (2006)			
B. indicus	151.85	1.18	215.83		349.64
		Jonsson (2006)		CEPEA (2013a, b, c)	
				Total potential loss	**3,236.35**

*Considering the following mean daily tick burdens: *B. taurus* - 94 ticks (SMITH et al., 2000), *B. indicus x B. taurus* - 32 ticks, and *B. indicus* – 3.3 ticks (GOMES et al., 1989). **Based on IBGE (2011).

The data on damage caused by *D. hominis* larvae to cattle productivity were based on Magalhães and Lesskiu (1982), who found a yearly reduction in weight gain of 40.6 g per larva. The estimates of economic losses due to the cattle grub focused on regions where this parasite is abundant and important. Thus, average infestations on *B. taurus* (74 larvae/animal/year) and *B. indicus* (18.2 larvae/animal/year) were estimated for the central-western and southern regions, as well as for the state of Paraná, based on several studies (MAGALHÃES; LESSKIU, 1982; SARTOR, 1986; GOMES et al., 1988, 1996; CARNEIRO et al., 1990; OLIVEIRA, 1991; PINTO et al., 2002; FERNANDES et al., 2008; SOUZA et al., 2010). Considering that 19.12 million *B. taurus* and 90.96 million *B. indicus* are at risk, the potential losses in weight gain due to this parasite amount to $201.93 million yearly.

The rate of damage to cattle hides caused by *D. hominis* larvae averaged 25.17% at slaughterhouses in the regions studied (BRITO; MOYA-BORJA, 2000; MARQUES et al., 2000; SANAVRIA et al., 2002), which represented annual losses of about $181.55 million. Cattle hide damage caused by both cattle grubs and cattle ticks reached a rate of 40%, as officially reported from a previous survey (BRASIL, 1983). Considering losses in relation to both weight gain and hide damage, the potential losses due to *D. hominis* larval infestation total $383.48 million (Tables 4 and 5).

Occurrences of navel myiasis due to screwworm have been reported in 40.7% of calves in central-western Brazil

Table 3. Economic losses due to the horn fly, *Haematobia irritans*, relating to beef cattle production in Brazil, in 2012.

	Live animals at risk*	Yearly weight loss per head	Total yearly weight loss	Price to producer	Potential loss
	(million head)	(kilogram)	(millions of kilograms)	(US$/kilogram)	(millions of US$)
Steers/heifers	113.09**	12.19 Bianchin et al. (2004)	1,378.57	1.62	2,233.28
Cows	38.13**	3.25 Bianchin and Alves (2002)	123.92		200.75
Calves	38.36***	2.00 Bianchin and Alves (2002)	76.72	CEPEA (2013a, b, c)	124.29
				Total potential loss	**2,558.32**

*Considering population in December 2012. **Based on IBGE (2011) and Anualpec (INFORMA ECONOMICS FNP, 2013). ***Based on IBGE (2011) and Censo Agropecuário (IBGE, 2012).

Table 4. Economic losses due to the cattle grub, *Dermatobia hominis*, relating to beef cattle production in Brazil, in 2011.

Beef cattle	Population at risk*	Average number of larvae per animal	Weight loss	Affected herd yearly loss	Price to producer	Potential loss
	(million head)		(kg/larva/year)	(millions of kilograms)	(US$/kilogram)	(millions of US$)
Bos indicus	90.96	18.20 Fernandes et al. (2008)	0.0406	67.21	1.62	108.88
Bos taurus	19.12	74.00 **	Magalhães and Lesskiu (1982)	57.44	CEPEA (2013a, b, c)	93.05

*Based on IBGE (2011). ** Carneiro et al. (1990), Gomes et al. (1988, 1996), Magalhães and Lesskiu (1982), Oliveira (1991), Pinto et al. (2002), Sartor (1986) and Souza et al. (2010).

Table 5. Economic losses due to the cattle grub, *Dermatobia hominis*, in the cowhide industry in Brazil, in 2012.

Cowhide	Yearly slaughtered animals	Damaged hides*	Total damaged hides	Raw cowhide value 2012**	Potential loss
	(million head)	(%)	(million)	(US$ per hide)	(millions of US$)
Beef cattle	19.55 IBGE (2013)	25.17	4.92	36.90 Scot Consultoria, 2013	181.55
				Total potential loss (Tables 4 and 5)	**383.48**

*Estimates based on Brito and Moya-Borja (2000), Sanavria et al. (2002) and Marques et al. (2000); **Considering 45 kg of raw hide per animal.

(BIANCHIN et al., 1992), which is the main region for raising beef cattle in this country. Although endectocide products have been widely used to prevent and treat navel myiasis in newborn calves throughout Brazil, considerable losses persist. Barros et al. (2010b) reported a 5.5% control failure rate for endectocide treatments against navel myiasis in calves, which was similar to the mortality rate (5.32%) observed among 432 calves monitored until weaning (BIANCHIN et al., 1992). Considering a natural occurrence of 40.7% for screwworm attacks among calves and that 5.5% of treated animals may still develop myiasis, the losses due to potential calf mortality were estimated to be $310.55 million (Table 6). Considering the population at risk to be just a small proportion of the calf population (i.e. only the animals presenting control failure and at risk of death), rather than the entire population of calves at potential risk of infestation, the estimated economic losses due to this parasite are probably closer to reality, but comparatively lower than those estimated for other parasite species. No estimate of the losses due to screwworm attacks among adult animals was possible, because of the lack of specific information, but this parasite and its economic implications certainly play an important role in several regions of this country.

The potential losses due to stable flies (*S. calcitrans*) were based on Kunz et al. (1991), who reported estimated losses of 100 g per steer per day in feedlots (50% of the cattle were exposed to stable flies) and a 27 kg decrease in milk production per cow per year (stable flies were present for six months), in the USA. Considering that there are 4.08 million feedlot cattle in Brazil (ABIEC, 2013), the losses due to *S. calcitrans* were estimated as

Table 6. Economic losses due to navel myiasis caused by the screwworm, *Cochliomyia hominivorax*, among calves in Brazil, in 2011.

	Population at risk*	Prevalence of screwworm myiasis in calves	Failure of navel myiasis control in calves	Average weaned calf value	Potential loss
	(million head)	(%)	(%)	(US$)	(millions of US$)
Calves	41.58	40.7	5.5	361.66	336.62
		Bianchin et al. (1992)	Barros et al. (2010b)	CEPEA (2013a, b, c)	

*Considering calves born in 2011. Based on IBGE (2011) and Censo Agropecuário (IBGE, 2012).

Table 7. Economic losses due to the stable fly, *Stomoxys calcitrans*, among dairy and feedlot cattle in Brazil, in 2011/2012.

	Population at risk	Milk loss	Total yearly loss	Price to producer	Potential loss
	(million head)	(liter/cow/year)	(millions of liters)	(US$/liter)	(millions of US$)
Dairy cattle	23.23	27.00	627.21	0.44	275.97
	IBGE (2011)	Kunz et al. (1991)		CEPEA (2013a, b, c)	
	Population at risk	**Loss at feedlots**	**Total loss at feedlots***	**Price to producer**	**Potential loss**
	(million head)	**(gram/head/day)**	**(millions of kilograms)**	**(US$/kilogram)**	**(millions of US$)**
Feedlot cattle	4.08	100.00	36.72	1.62	59.49
		Kunz et al. (1991)		CEPEA (2013a, b, c)	
				Total potential loss	**335.46**

*Considering an average feedlot period of 90 days.

Table 8. Economic losses due to cattle parasitism in Brazil.

Parasite	Millions of US$
Gastrointestinal nematodes	7,107.97
Cattle tick, *Rhipicephalus* (*Boophilus*) *microplus*	3,236.35
Horn fly, *Haematobia irritans*	2,558.32
Cattle grub, *Dermatobia hominis*	383.48
Screwworm fly, *Cochliomyia hominivorax*	336.62
Stable fly, *Stomoxys calcitrans*	335.46
Total potential loss	**13,958.20**

$59.49 million (Table 7). Regarding milk production, the losses inflicted on dairy cattle were estimated as $275.97 million. The total loss of $335.46 million attributed to stable flies is probably an underestimate, since the impact of this pest on pastured cattle and the size of the affected population, particularly during severe outbreaks, is unknown and was not included here. In addition to the fact that losses during outbreaks are much higher than in regular infestations, it should be considered that the frequency and severity of these outbreaks in Brazil are increasing dramatically due to the rapid expansion of ethanol production from sugarcane. The present estimate of potential losses due to stable flies is much lower than the economic impact of $2,211 million per year recently estimated for this pest among dairy and beef cattle in the USA (TAYLOR et al., 2012). Further investigations are needed regarding the current impact of stable flies on cattle production in Brazil.

Thus, the following economic losses, in millions of dollars, were estimated regarding the impact of these parasite species or groups for the respective cattle populations that were considered to be at risk: gastrointestinal nematodes ($7,107.97), cattle ticks ($3,236.35), horn flies ($2,558.32), cattle grubs ($383.48), screwworms ($336.62) and stable flies ($335.46).

The annual potential economic losses due to the five major ectoparasites and gastrointestinal worms of cattle in Brazil reach the impressive amount of $13.9 billion (Table 8). This reflects the favorable environmental conditions for both livestock and their parasites in this country. The situation is aggravated by parasite control bottlenecks. When distributed across the national cattle herd (more than 212 million head), a yearly loss of $65.49 per head was found, which might seem to be more tolerable. However, considering an average age at slaughter of 36 to 42 months, this yearly impact actually represents 32% of the beef cattle sale price (CEPEA, 2013a, b, c), thus making the potential damage due to cattle parasitism unacceptable for both producers and the cattle industry.

Regardless of the limitations of some of the baseline studies used to develop these estimates, particularly when extrapolated from local situations to a national scale, the general picture obtained from the present effort demonstrates the magnitude and importance of cattle parasitism in Brazil and the unfeasibility of a profitable livestock industry without proper parasite control.

Traditionally, chemicals have been used to manage parasites, with an impact on the wellbeing and health of domestic animals, including food-producing livestock (ECOBICHON, 2001; OLIVEIRA PASIANI et al., 2012). However, indiscriminate use of chemical pesticides for veterinary use has driven parasite populations to become resistant to many of them (ANDREOTTI et al., 2011; KAPLAN; VIDYASHANKAR, 2012; CASTRO JANER et al., 2012). Further studies assessing the contribution of pesticide resistance to the economic harm resulting from parasitic diseases in cattle are warranted.

Ultimately, establishment of a national program of parasite control and resistance management, as well as a solid extension program, will not only reduce the real impact of parasitism on the Brazilian cattle industry – taking it far from the potential damage currently estimated – but also enhance public and animal health.

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