Letter to the Editors

Increasing beef production won't reduce emissions

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De Oliveira Silva et al. (2016) model beef production in the Brazilian *Cerrado*, and conclude that – if accompanied by tight deforestation control – increasing production could lower emissions by incentivising better pasture management. While their analysis is valuable in identifying the conditions under which increasing meat consumption could be compatible with reducing greenhouse gas emissions, we believe that there is little chance of such conditions occurring in practice. Overall, increasing beef consumption and production is unlikely to be an effective lever for reducing emissions, and is more likely to exacerbate deforestation.

The analysis by de Oliveira Silva et al. shows that reduced emissions are only possible if clearance of savannas and forests is halted almost completely. However, even if the Forest Code is implemented perfectly, ~40 million hectares of native vegetation remain legally available for conversion to pasture in the *Cerrado* (Soares-Filho et al. 2014). Halting deforestation on these lands would require a degree of political determination, legislative change and effective enforcement beyond even that achieved in the Amazon. Even in the 9%

of the *Cerrado* with formal protection, deforestation has only been reduced, not eliminated (Carranza et al. 2014). According to de Oliveira Silva et al., there was zero net deforestation for pasture between 2006 and 2015 (Supplementary Table 3). However, there are two reasons to be skeptical that pasture has not replaced native vegetation during that time. First, it is difficult to distinguish pasture from native *Cerrado* vegetation using satellite data (Spera et al. 2016). Second, net change is not the same as gross change. Cropland area in the *Cerrado* has doubled since 2003, at the expense of both pasture and native vegetation (Spera et al. 2016). Considering both cropland expansion and the goal of ending deforestation, net reductions in pasture area are needed to avoid further displacement of pasture into native vegetation.

De Oliveira Silva et al. present no evidence to support their assumption that higher beef production would result in more carbon captured in pastures. While higher profits might allow investment in pasture restoration, higher stocking rates can instead result in reduced soil organic carbon stocks (Navarette et al. 2016). Improved pasture management, if implemented, could increase grassland productivity, but this increased productivity will only translate into increased carbon storage if it outpaces the higher amount of carbon removed in the form of beef. Grazing strongly reduces the share of net primary production (NPP) that can accumulate in an ecosystem (Soussana et al. 2007), with up to 60% of above-ground dry matter ingested by livestock in intensive grazing systems (Lemaire & Chapman 1996). For this reason, increased NPP is not a good surrogate for increased carbon storage (net biome productivity; NBP). Pasture productivity can also be increased on a shrinking pasture area without any increase in beef production. Furthermore, by treating the *Cerrado* as one large farm, de Oliveira Silva et al. omit important heterogeneity in how ranchers respond to beef price changes. When beef prices fall, marginally profitable farms may take land out of

production or go out of business. Abandoned pasture could then revert to secondary vegetation, storing carbon in the process (Chazdon et al. 2016). This outcome is not considered, meaning the potential for reduced beef demand to promote carbon sequestration is underestimated.

The study underlines the importance of controlling deforestation for reducing emissions from the agricultural sector, but other policy levers appear more promising than increasing beef production. Such levers include making access to agricultural credit conditional on achieving habitat conservation targets (Nepstad et al. 2014), incentives for forest restoration (Latawiec et al. 2015) and programmes of support to ranchers to improve pasture management (Strassburg et al. 2014). A shift away from meat-rich diets would reduce the amount of land needed for food production, leaving more scope for conserving native vegetation (Erb et al. 2016). More emissions could be captured if cattle herds are reduced, and if land-sparing policies are developed to promote improved pasture management on a smaller area, coupled with protection and restoration of native vegetation (Cohn et al. 2014, Lamb et al. 2016). Taking action to reduce beef demand and cattle herds would not only help to reduce emissions, but also to safeguard the soils, water and biodiversity of the *Cerrado*.

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