Supporting Information

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SI Text

Land-Cover and Land-Use Change. By 2006, one-third of Mato Grosso was already in pasture or cropland (Table S1), with croplands accounting for 29% of all agricultural land. Of the remaining area, there was 378,735 km^2 of intact forest and 231,487 km^2 of cerrado (Table S1). The two BAU scenarios project that 49% of Mato Grosso will be converted to agriculture by 2050 (Fig. S1); one-third of the forest area will be lost by 2050, and cerrado will be reduced by 7%. In the BAUCrop scenario, cropland areas will account for >50% of all agricultural land, an increase of 162% over the study period. Pastures will cover 80% of all agricultural land by 2050 in the BAUPasture scenario, increasing by 140,813 km^2 over the study period. For the GOV scenarios, there will be 10% loss of forest areas and a 3% loss from cerrado by 2050. Agriculture will cover 37% of the state by 2050 in the GOV scenarios. The increases in cropland areas will be more modest in the GOVCrop scenario (46%), compared with the BAUCrop scenario, and will account for 37% of all agricultural land. Pasture areas in the GOVPasture scenario will increase 8%.

TEM Datasets. To develop regional estimates of carbon and nitrogen stocks and fluxes, the TEM needs spatially explicit data for elevation, soil texture, land cover, climate, and atmospheric chemistry variables at a spatial resolution of 1 km × 1 km. The elevation and soil texture are from Galford et al. (1). For climate, we used spatially explicit data sets recently developed by Melillo et al. (2) to represent future global climate as influenced by a policy to control greenhouse gas emissions from industrial and fossil fuel sources with an atmospheric stabilization of 550 ppmv CO_2 concentration by 2100. Atmospheric CO_2 concentrations are global annual averages and reach 473 ppmv by 2050 (Fig. S2*A*). The monthly mean air temperature and precipitation data were downscaled from a 0.5° latitude × 0.5° longitude spatial resolution to 1 km^2 such that all 1-km grid cells contained within a much larger 0.5° grid cell simply used the value of a climate driver from the larger grid cell. Because sharp climate gradients generally do not occur in the state of Mato Grosso, we believed this to be an adequate approach. For ozone, the AOT40 index increased around 2025 and then decreased to just above 2000 levels by 2050 (Fig. S2*B*). The average annual air temperature increased 0.2 degrees every decade (Fig. S2*D*). Regional precipitation showed no strong trend over the study period but high interannual variability (Fig. S2*D*).

Uncertainty in Estimating Greenhouse Gas Emissions. The extent of deforestation is the primary source of uncertainty in our estimates of future greenhouse gas emissions (*Background and Methods*). Assumptions about biomass can have a large impacts on the carbon emissions from deforestation (1). For contemporary conditions, TEM is well calibrated for Amazon undisturbed forest ecosystems across the Amazon (3). In Mato Grosso, our model estimates a forest biomass of 217 ± 75 Mg C ha^{-1} (1), which reflects primarily the rainfall gradient. This biomass estimate is within recent reported biomass ranges 130–442 Mg ha^{-1} (4), 130–220 Mg ha^{-1} (5), and 169 Mg ha^{-1} (6), which are also indicative of the regional rainfall gradient. We may overestimate carbon loss at the time of clearing in areas where selective logging occurred, which typically happens within a few yearsbefore deforestation (7, 8) or in areas that are subjected to wild fires induced by logging or climate-related changes in temperature and humidity (9). Constraints on uncertainty for N_2O emissions are discussed in *Background and Methods*.

The impact of increasing cattle stocking rates linearly impacts methane emissions, but not other greenhouse gas emissions, in our greenhouse gas budget. In the case of the high stocking rates, 7 animal units per hectare, methane emissions would increase 7-fold (ranging by scenario from 2.4 to 3.7 Pg CO_2-e cumulative emissions from 2006 to 2050). As described in *Background and Methods* and in Galford et al. (1), cycling of carbon and nitrogen in pastures is based on assumptions of constant turnover rates that are not affected by the cattle stocking rates.

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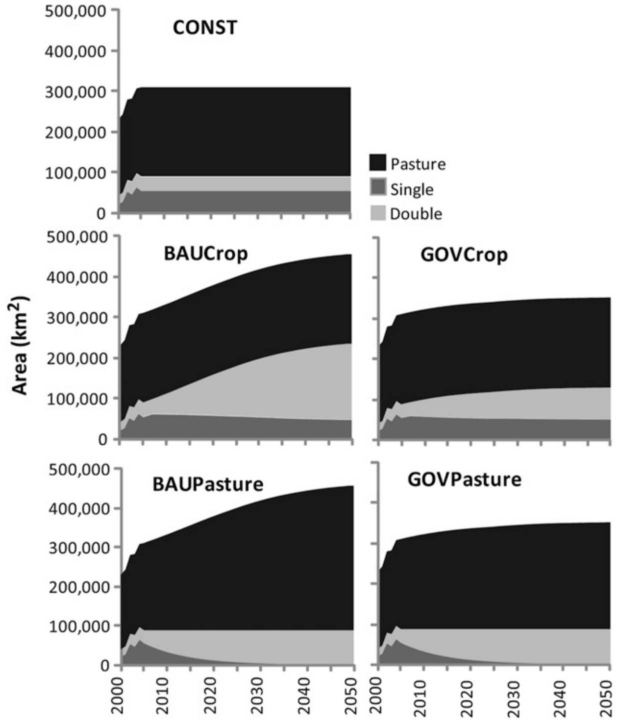

Fig. S1. Change in land use areas (km^2) by scenario.

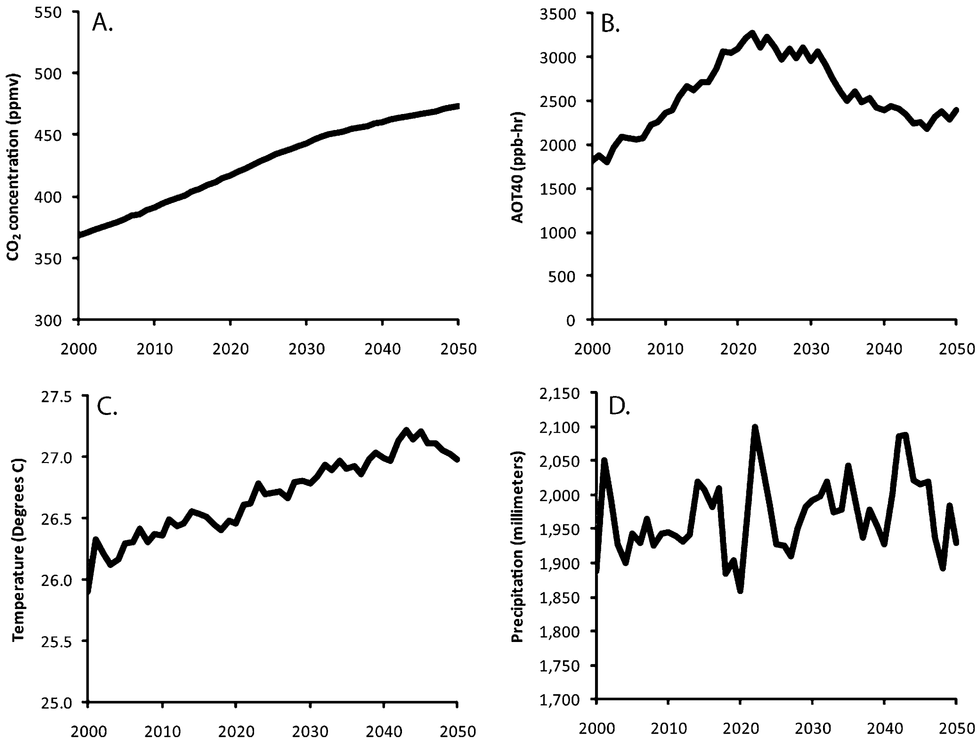

Fig. S2. Projected changes in environmental factors, as used in TEM, including atmospheric CO_2 concentrations (*A*), mean regional AOT40 ozone index (*B*), regional annual mean air temperatures (*C*), and regional annual precipitation (*D*).

Table S1. Potential vegetation types (1), their original extent before land use, and extent of natural vegetation and land use by 2050 in each scenario (km^2)

Land cover/land use	Natural extent	CONST	BAUCrop	BAUPasture	GOVCrop	GOVPasture
Tropical evergreen forests	137,670	123,936	65,845	65,845	112,012	112,012
Tropical deciduous forests	371,876	229,054	163,417	163,417	206,513	206,513
Riparian forests	38,602	25,745	21,175	21,175	24,658	24,658
Cerrado stricto senso (savanna)	264,572	166,854	157,012	157,012	163,266	163,266
Cerradão (dense savanna)	41,191	18,753	16,611	16,611	18,104	18,104
Campo limpo (savanna grassland)	65,738	45,880	41,900	41,900	45,017	45,017
Single cropping	—	54,159	47,560	523	50,289	523
Double cropping	—	35,374	186,947	89,010	80,091	89,010
Pasture	—	221,092	221,092	366,066	221,092	261,939
Other (water, unclassified)	5,576	4,378	3,666	3, 666	4,183	4,183

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