



Figure 9. Greenhouse gas emissions from biomass loss and fertilizer additions. Pasture represents cropland extensification into areas of pasture that were previously created from areas of native vegetation. The range of emissions comes from a low, mid-, and high range of biomass estimates (Table 4).

example, fairly level topography (Jasinski et al. 2005). Lands are cleared through slash and burn until there are no roots or slash to foul machinery. To prepare for planting crops, soils may be amended with lime to reduce the aluminotoxicity; fertilized with nitrogen, phosphorus, and potassium; and often planted for 1–2 years with upland rice (Barbosa Filho and Yamada 2002; Fundação Agrisus 2006; Sanchez et al. 1982). The large-scale nature of croplands in the Amazon frontier is coupled both to scale dependence of profitable farming and the investors who will encourage that scale. From our observations, extensification of new single crops largely proceeds by expanding into adjacent lands rather than leaping to new

Table 5. Total annual greenhouse gas budget (CO₂-e emissions yr⁻¹) for Mato Grosso accounting for conversions to pasture and cropland, pasture maintenance, and methane emissions from cattle. This budget accounts for cattle emissions using a mean emission rate of 55 kg methane per head (Steudler et al. 1996) and a cattle herd of 19 600 000 for Mato Grosso (IBGE 2009).

Emissions estimate		Tg CO ₂ -e yr ⁻¹
DeFries et al. 2008	Conversion of forest to pasture (CO ₂ , CH ₄)	199.7
Galford et al. (this paper)	Conversion of pasture and natural ecosystems to cropland (CO ₂ , CH ₄)	178.9
DeFries et al. 2008	Pasture maintenance (fire; CO ₂)	22.0
After Steudler et al. 1996	Cattle herd (CH ₄)	21.5
Galford et al. (this paper)	Cropland fertilization (N ₂ O)	0.4
Total		422.5