Figure 3. Total cropland area (km^2) in Mato Grosso by natural ecosystem of origin.

Our statewide estimates of cropland area (see section 3.2.1) generally agree with government estimates (IBGE 2009). The remote sensing estimates tend to under-represent the cropland area. On average across the study period, the remote sensing data detects 65% of the cropland estimated in IBGE 2009. Looking at individual years, the lowest agreement between these datasets is 40% in year 2001 and the highest is 82% in year 2003.

3.2. Changes in croplands

3.2.1. Cropland extensification

Total cropland area in Mato Grosso more than doubled from 2001 to 2006, increasing from 45 497 to 99 488 km^2 (Figure 3). We document an average annual rate of increase for agricultural extensification of 0.47%. By 2006, Mato Grosso croplands covered 11% of the state (Figure 4).

We see different cropland extensification rates for the different natural biomes (Figure 4). When weighted by area of potential natural vegetation type, the cerrado supplied the largest relative amount of land for croplands, with croplands accounting for 18% of the cerrado's potential area as estimated by Mello (Mello 2007). Over 22 000 km^2 of new croplands emerged in the cerrado biome, a 10% increase in cropland area for Mato Grosso's cerrado region (Figure 4). Spatially, we see that new extensification occurs around areas of previously existing croplands, giving a "clumping" effect to the cropland distribution (Figure 5).

Rates of conversion to cropland vary by land-cover and land-use sources and exhibit interannual variability. On average, over 60% of conversions in the cerrado region were two-phase transitions: cerrado to pasture and then pasture to cropland Figure 6). In the cerradão regions, 70% of new croplands followed such a two-phase transition. The sequence of forest-to-pasture and then pasture-to-cropland conversions accounted for over 60% of the forest land-use transitions, and total cropland area in this region increased 24 200 km^2 over the study period. The rates of pasture-to-cropland transitions show high interannual variability, particularly in areas of former cerrado (Table 4).