Declining crop yields, consequent to continuous cropping without external addition of adequate nutrients, is a major problem facing smallholder farmers in the tropics. The high cost of inorganic fertilizers has led to increased interest in the use of leafy biomass from woody species as a source of nutrients to annual crops. This dissertation reports the results of a study, conducted in the subhumid highlands of Kenya since 1992, on the influence of soil- incorporated leaf prunings of two agroforestry tree species (Calliandra calothyrsus--calliandra and Leucaena leucocephala--leucaena) on maize yield and soil fertility status in sole cropping and alley cropping systems. Inclusion of calliandra hedges on cropland (alley- cropping) adversely affected crop yields during the four- year study period, whereas alley cropping with leucaena increased crop yields. In all the treatments, mineralization of soil N was at its peak four weeks after maize planting. Cumulative mineralized N at week 20 ranged from 115 to 360 kg N/ha/season; the non-alley-cropped, nonfertilized control giving the lowest, and the prunings-incorporated treatments giving the highest amounts of N. Total N uptake by maize, ranging from 40 to 160 kg/ha/season, was lowest in the alley-cropped, prunings-removed plots, and the highest in the prunings-incorporated plots.

Studies with 15N indicated that soil application of N-rich biomass contributed more to the long-term build up of soil N than to meeting the nutrient requirements of the current season's crop: the largest fraction of N (55% to 69%) in the tree biomass that was added to the soil was left in the soil N. pool at the end of the current cropping season, 8% to 13% was recovered in the maize, and 2% to 3% in the tree hedges; 20% to 30% could not be accounted for. A separate study on decomposition of tree-leaf biomass of some commonly used agroforestry tree species in the region revealed that the prevailing general assumption that decomposition of tree biomass is determined predominantly by plant quality factors was not always true: during seasons of erratic climatic changes (e.g., fluctuating temperatures), climatic factors were more important than plant quality factors in influencing the rate of biomass decomposition.