

Carbon stocks in Indonesian homegarden systems: Can smallholder systems be targeted for increased carbon storage?

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Abstract

Homegardens are a common smallholder agroforestry system in Indonesia and throughout the tropics. These speciesrich, tree-based systems produce non-wood and wood products for both home use and market sale. Due to their high biomass, these systems simultaneously offer potential for carbon (C) storage. While small size limits the amount of C stored by individual smallholder agroforestry systems, on a per area basis these systems can store as much C as some secondary forests. In aggregate, smallholder homegarden agroforestry systems can contribute significantly to a region's carbon budget while simultaneously enhancing smallholder livelihoods. A field study in Lampung, Indonesia indicates that homegardens with an average age of 13 years store 35.3 Mg C ha⁻¹ in their above-ground biomass, which is on par with the C stocks reported for similar-aged secondary forests in the same area. However, to compare accurately the C stocks of different land-use systems a scale is required that adjusts C stocks of the systems' ages and rotation lengths to a common base. The time-averaged C stock, which is half the C stock at the maximum rotation length, serves this purpose. Our projections reveal that, depending on management options, the time-averaged above-ground C stocks of homegarden systems could vary from 30 to 123 Mg C ha⁻¹. These projected timeaveraged above-ground C stocks of homegardens are substantially higher than those of Imperata-cassava systems (2.2 Mg C ha⁻¹), which is an extensive vegetation type in the study area. If homegarden systems and other smallholder tree-based systems were to expand in currently degraded and underutilized lands, such as Imperata grasslands, the C sequestration potential would be about 80 Mg C ha⁻¹, with considerable variation depending on species composition and management practices. Clear opportunity exists to induce management that leads to higher C stocks at the systems level. However, incentive mechanisms are needed that assure smallholders will benefit from selecting management practices that favor higher C stocks.

Key words agroforestry ; agroforestation; carbon sequestration; certified emissions reductions (CERs); clean development mechanism (CDM); climate change; greenhouse gas; *Imperata* grasslands; land rehabilitation; tree farming