



Biomass and carbon budgeting of sustainable agroforestry systems as ecosystem service in Indian Himalayas

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ABSTRACT

Adoption of agroforestry is paramount as a climate change mitigation and adaptation strategy. The assessment of plant biomass is crucial for understanding the vulnerability of biological systems to climate change. In the present study, agroforestry systems viz., agrisilviculture (AS), agrihorticulture (AH), agrihortisilviculture (AHS) and agrisilvihorticulture (ASH) were investigated for biomass production and carbon stock in vegetation as well as in soil in the Indian central Himalaya along the elevation i.e. E_1 (<1100 m), E_2 (1100–1400 m), E_3 (1400–1700 m), E_4 (1700–2000 m) and E_5 (>2000 m). Mean aboveground and belowground biomass were 73.9% and 26.1%, respectively, of total biomass (64.4 t ha^{-1}) in agroforestry systems. Fodder and/or timber trees accounted for 31% (in AHS) to 74% (in AS) of total biomass, while fruit trees accounted for 18% (in ASH) to 73% (in AH) of total biomass. The contribution of agriculture crops to total biomass fluctuated between 19% (in ASH) and 26% (in AH). Total vegetation biomass, soil carbon and total carbon density in agroforestry systems increased significantly along the elevation, with maximum biomass at elevation E_5 (32.0 t ha^{-1} , 64.7 t C ha^{-1} and 96.7 t C ha^{-1}). Total biomass of vegetation among agroforestry systems differed significantly. Soil carbon stock was highest in AHS (59.5 t C ha^{-1}) and total carbon density (vegetation + soil) was highest in ASH (93.0 t C ha^{-1}). Thus, in Indian Himalayas, vegetation biomass, carbon stock, soil and total carbon (vegetation + soil) stock increased along the elevation.

Abbreviations: AG: aboveground; BG: belowground; WD: wood density; VOB: volume over bark; BEF: biomass expansion factor; AS: agrisilviculture; AH: agrihorticulture; ASH: agrisilvihorticulture; AHS: agrihortisilviculture; E: elevation; C: carbon; CO_2 : carbon-di-oxide; IPCC: Intergovernmental Panel on Climate Change; DBH: diameter at breast height; AGBD: aboveground biomass density; BGBD: belowground biomass density; GSVD: growing stock volume density

ARTICLE HISTORY

Received 29 January 2019
 Accepted 23 March 2019

KEYWORDS

Agroforestry; biomass; carbon budgeting; Himalayas; elevation gradient