Changes in Biomass and Carbon Stock of Mangrove Forest in Bani, Pangasinan Six Years after Typhoon Chan-hom

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Abstract

Vegetative and soil carbon pools are critical for determining long-term changes in carbon stocks linked to disturbances and climate change. In this study, we determined the vegetation and soil carbon pools of mangrove forests of Bani, Pangasinan which was severely damaged by tropical typhoon Chan-hom in 2009. Six years after the typhoon, we investigated indication of recovery based on carbon stocks in natural and planted mangrove stands. Tree height and diameter at breast height were used in tree allometric equations to estimate the above-ground and below-ground C-stocks. To quantify soil C-stock, soil cores with 100cm-depth were collected using core tubes and were subsampled at 1-, 2- and 5-cm depth intervals. Each subsamples were dried and homogenized and were analyzed to determine organic carbon content using loss on ignition (LOI) method. The amount of carbon per cm^3 of each depth interval was added to determine the total C-stock. Preliminary results showed higher vegetation C-stocks in the natural stands than the restored stands. The soil C-stocks in both sites showed decreasing trend with depth, although the planted stands appeared to have lower values at 0-20cm depth than the natural stands. This imply that the planted mangrove stands might take longer time to recover its pre-disturbance C-stock as compared to natural mangrove stands.

Introduction

Mangroves serve as coastal protection against typhoons and storm surges and as climate mitigating measures to climate change through carbon sequestration. Monospecific plantations are widely implemented in the Philippines to increase remaining mangrove forest cover. They also utilize the potential to capture and store significant amount of atmospheric and oceanic CO_2 through carbon sequestration. Donato *et al.* (2011) reported that carbon stocks in mangrove forests are five times higher than any other terrestrial forest. The recorded C-stock in the Philippines is 442 Mg C/ha, 20-60% lower than other Asian countries. In the event of a disturbance (such as a strong typhoon), mangrove biomass and consequently carbon stocks, will be drastically reduced by at least 60% (Salmo III *et al.* 2014). As the

typhoon-damaged mangroves recover (through refoliation, coppicing, seedling recruitment and growth), biomass and carbon stocks will also increase. This study aims to document and evaluate post-typhoon changes in biomass and carbon stocks of planted mangroves in Bani, Pangasinan which was damaged by Typhoon Chan-hom in May 2009.

Materials and Methods

The carbon stock of a mangrove forest were determined through the measurements of above-ground biomass (AGB), below-ground biomass (BGB) and soil carbon content. These parameters were measured from nine randomly distributed sampling plots (of 5m radii) corresponding to natural and planted mangrove stands (see Salmo III et al. for site description). The above and below-ground carbon stocks were estimated by using diameter-at-breast height, and calculating biomass through allometric equations for corresponding species (Komiyama *et al.* 2008). Soil carbon (per certain depths at 1-, 2- and 5-cm intervals) was determined through loss on ignition method. The results of this study were compared to the pre-typhoon, 1-, 7-, and 9-month post-typhoon data from Salmo III *et al.* (2014). Six-year post-typhoon C-stocks between natural *Avicennia* stands and planted *Rhizophora* were also compared.

Summary and Implications

Six years after Typhoon Chan-hom, the typhoon-damaged mangroves showed signs of recovery – through refoliation. The tree density increased by 160%; the AGB by 200%; and soil carbon by 129%. The total C-stock increased by 140% from 0.5-month post-typhoon. However, the soil carbon and total C-stock in planted stands was lower by 40-50% and 40-80%, respectively as compared with the natural stands. , while total C-stock was lower by 40-80% (*Fig.* 1).

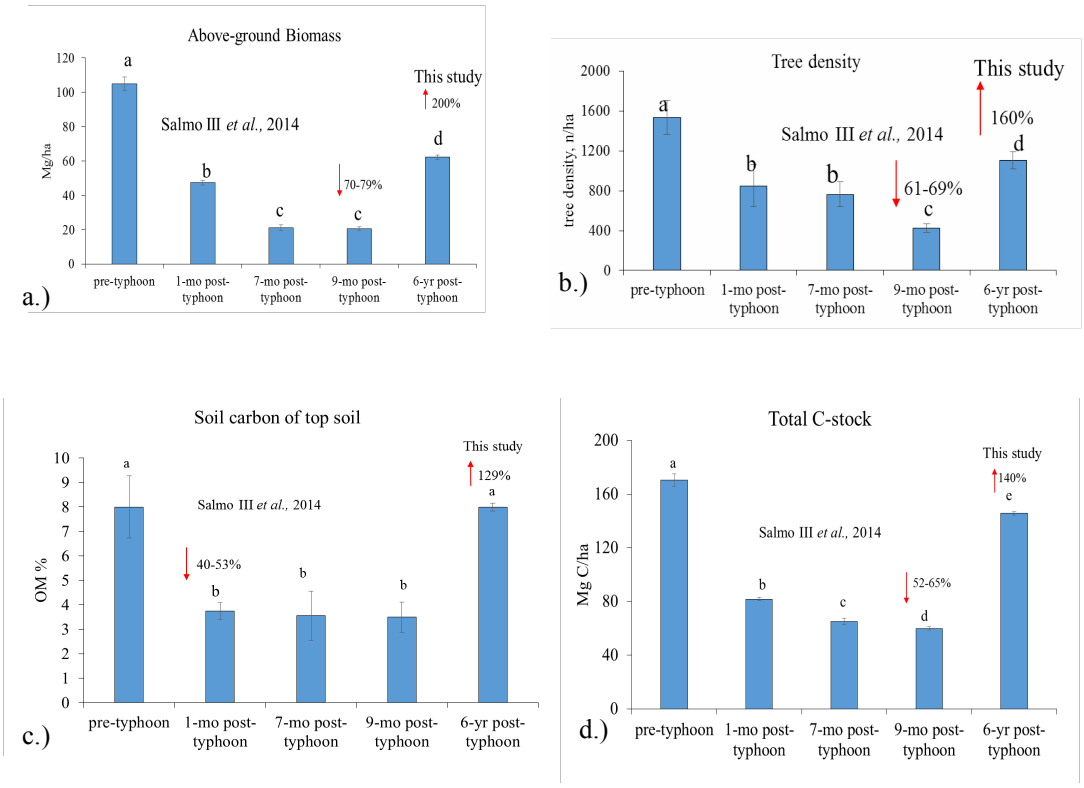

Figure 1. Pre- and post-typhoon changes in (a.) AGB; (b.) tree density; (c.) top soil carbon; and (d.) total C-stocks. Different letters between bars indicate significant difference between periods at $P < 0.05$.

Overall, the vegetation C-stocks of the damaged sites is not yet comparable with its pre-typhoon state but is most likely leading towards the original condition based from the significant improvement in the post-typhoon C-stocks. Unlike the above- and below-ground C-stock, the soil carbon may have already recovered to its pre-typhoon state. This may be due to the high source of inputs from leaf litter and increased water activity.

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