Carbon Sequestration by Mangrove Forest

Mangroves are unique forest type that grow in the intertidal zone of tropical and subtropical regions (Alongi, 2002). They are composed of salt-tolerant plants that have developed adaptations in this relatively harsh environment with varying levels of salinity and nutrient poor-soils. Their ecological importance and socio-economic significance are widely recognized (FAO, 2007) yet, they account for less than 1% of the total area of tropical forests worldwide only.

The issue of global climate change is now a major public concern and the predicted impacts are alarming particularly for coastal communities (Duncan et al., 2016). Climate change “*means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time period*s (UNCCC, 1992). The IPCC (2007) said that “*warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea-level*.” They further concluded that carbon dioxide (CO2) emissions from human activities are the largest anthropogenic factor contributing to climate change

Predicted impacts include gradual increase in frequency and power of cyclones, storm surges, hurricanes, and sea level rise (Pramova et al., 2013; Mori and Takemi, 2016). Along coastal areas are important ecosystems, such as mangroves, salt marshes, and seagrass beds that have been shown to be among the most efficient carbon (C) sinks on the planet for their ability for carbon sequestration (Donato et al., 2011). According to Bouillon et al. (2008), “*the global net primary production (NPP) of mangroves is estimated to be 218 Tg ha-1 of carbon, accounting for nearly half of the total NPP of all coastal wetlands*.” In addition, about 95% to 99% of total carbon stocks of saltmarsh and seagrass ecosystems are stored in the soils beneath them, while in mangrove systems, 50% to 90% of the total carbon stock is in the soil; the rest is in living biomass (Lawrence 2012). Thus, making them one of the most carbon-rich forest types in the tropics with an average of 1023 Mg·ha−1 carbon stored that is three times as much mean carbon per hectare as land based tropical forests (Donato et al., 2011).

A lot of attention is now focused on mangrove forests to offset carbon emissions due to its cost effectiveness, high potential rates of carbon uptake, and associated environmental and social benefits (Gevaña et al. 2008; Cui et al., 2018). However, mangroves are nonetheless still facing an extensive loss due to anthropogenic activities such as deforestation, conversion to aquaculture ponds and land conversion for development purposes. Their degradation results in the loss of their ecosystem functions and services, biodiversity, and a decrease in their C sequestration potential (Duke et al., 2007; Mcleod et al., 2011). When mangroves are lost, there is an acceleration of remineralization and erosion processes of organic carbon (OC) in mangrove sediments, producing significant amount of greenhouse gases (GHG) into the atmosphere (Bouillon, 2011; Lovelock et al., 2011).

In the Philippines, the total area of mangroves has decreased by almost half, from 400000-500000 ha recorded several decades ago (Brown & Fischer, 1920; Primavera, 2000) to the current estimate of 259,600 ha (Siikamaki et al*.*, 2012). Primavera (2000) added that mangroves have suffered the earliest and greatest degradation in the Philippines because of their relative accessibility and a long history of conversion to aquaculture ponds. These problems are likely to worsen as human induced activities push further into the mangrove domains. The country is catching up with inventories of carbon stock (Lasco and Pulhin 2000, 2004; Camacho et al. 2011; Gevana and Pampolina 2009; Castillo and Breva 2012; Abino, Castillo and Lee 2014). These studies provide additional evidences on the importance of mangroves in climate change mitigation through their ability to sequester CO2 (as carbon sink) from the atmosphere but are also potentially generators of CO2 (as carbon source) and other greenhouse gases when destroyed of converted to other uses.

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