



## Estimation of carbon pool in soil, above and below ground vegetation at different types of mangrove forests in Peninsular Malaysia



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### ABSTRACT

This paper evaluated the total carbon stock of mangrove ecosystems in two contrasting sites: a fishing village in Delta Kelantan (DK) and Ramsar sites in Johor Park (JP). In both sites, aboveground carbon was significantly higher than belowground carbon, and stems contained more carbon than leaf and root partitions. The average carbon concentration of individual mangrove species (44.9–48.1%) was not significantly different but the larger biomass of the DK samples resulted in vegetation carbon stock that was higher than that in JP. Season played an important role in soil carbon stock—a pronounced wet season in DK coincided with the dry season in JP. The total carbon pool was estimated to be 427.88 t ha<sup>-1</sup> in JP and 512.51 t ha<sup>-1</sup> in DK, where at least 80% was contributed by soil carbon. The carbon dioxide equivalent was 1570.32 t ha<sup>-1</sup> CO<sub>2</sub>e (JP) and 1880.91 t ha<sup>-1</sup> CO<sub>2</sub>e (DK).

### 1. Introduction

Four countries (Indonesia, Brazil, Australia and Mexico) account for about 42% of all mangroves, and 64% of the total mangrove area is found in just 10 countries (Giri et al., 2011). Southeast Asian mangroves are the best developed and probably the most species-diverse in the world (Giesen et al., 2007). Yet, carbon studies on mangroves are limited. The carbon studies of mangrove and ocean ecosystems are known as blue carbon studies (McLeod et al., 2011). According to Herr et al. (2012) 'blue carbon' is carbon stored, sequestered or released from vegetated coastal ecosystems such as tidal marshes, mangroves and sea grass meadows, while Pendleton et al. (2012) refers to 'blue carbon' as mangrove forests, sea grass meadows, tidal marshes—vegetated coastal ecosystems that represent significant carbon stocks. Despite that, coastal vegetation continues to disappear and degrade as a result of continuing development pressures.

Blue carbon studies are crucial to understand global warming issues. According to Sinha (2005), global warming is described as the observed and projected increase in globally averaged temperatures over time and a dynamic system, which means it has occurred in the past and will continue to occur in the future. The concentration of carbon dioxide (CO<sub>2</sub>) has increased markedly at a rate of 2.0 ppm/year from 2000 to 2009 (Lichtfouse et al., 2015). Climate change is attributed to human

activities that have increased global CO<sub>2</sub> content in the atmosphere. The impacts of climate change are evident on a global scale. There are also many major sources of gas emissions especially in industry, energy consumption and transport. This has fuelled interest in studying the capacity of carbon regulation in forests and other terrestrial and wetland ecosystems. One of the elements in blue carbon studies is soil organic carbon (SOC), which is an essential part of soil physical and chemical properties (Jobbágy and Jackson, 2001; Deng et al., 2013). In addition, it is a key element in the process of trapping atmospheric CO<sub>2</sub> in terrestrial ecosystems through primary production (Deng et al., 2013). Wetlands play a key role as suppliers of environmental services, with carbon sequestration being the most important service (Donato et al., 2011). Reservoirs of SOC can act as sources or sinks of atmospheric CO<sub>2</sub>, depending on land use practices, climate texture and topography (Cerón-Bretón et al., 2011). Forestry activities such as tree-planting can sequester carbon from the atmosphere, creating a carbon sink, although forest itself is a potential as a carbon source (Hemati et al., 2015; Phang et al., 2015). Uniquely, forestry practices are a serious part of the climate change problem and a key part of the solution. Trees absorb CO<sub>2</sub> from the atmosphere during photosynthesis and store carbon in their stems, branches and roots, which also transfer carbon to the soil (Ashman and Puri, 2002).

Globally, there has been an increasing number of carbon study with

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