Research Article

Rate of Carbon Storage in Soil of Natural and Degraded Mangrove Forest in Peninsular Malaysia

The rate of economic advancement in developing countries is gradually becoming antagonistic to environmental protection and to this end mangrove forests are gradually disappearing. Such development potentially adds to the pain experienced from global warming. Mangrove forest protection is necessary consequent upon the evidence of its carbon sequestration potentials. Hence, this study aimed to document the carbon storage rate in the soil of Peninsular Malaysia as it relates both natural and degraded mangrove areas. While the study areas were characterized of their associated trees/plant species distribution, 18 sampling spots were used in each area for the study. Both study areas showed high organic carbon content across three climate periods: dry, wet, and intermediate seasons. However, both organic carbon content and carbon storage rate were more pronounced during the dry season. Despite the degraded nature of the Sungai Haji Dorani mangrove forest, its total carbon value of 25.26 kg C m$^{-2}$ was higher compared with that found in Kuala Selangor, a natural mangrove forest (22.61 kg C m$^{-2}$). The climate period plays a significant role in the accumulation of organic matter and carbon content of the mangrove forest in Malaysia which is a reflection of a significant carbon sequestration potential.

Keywords: Carbon sequestration; Climate periods; Forest ecosystems; Organic carbon

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1 Introduction

Climate change is no longer just a growing concern but rather a nature issue both at the global and local levels. Especially in the presence of the continued quest for growth in economy, a consequently raise in the atmospheric CO$_2$ levels is generating heated debates due to the environmental implications, global warming being the major impact. The foregoing have called for ameliorating steps or approaches typical of reducing atmospheric CO$_2$ to reasonable levels, and ensuring a more sustained carbon cycle that will see carbon storage in a holding system for longer times. To this effect, the forest ecosystem including wetland green assembly has been reported to store carbon for a green deal of time [1, 2]. Therefore, the understanding how relevant forest/wetlands ecosystem can be to our immediate environment has become extremely important just as the CO$_2$ in the atmosphere has shown a difference of 497 ppm between what was obtained in the pre-industrial era (280 ppm) and now (387 ppm). Even with the role of some nations in ensuring stability of the greenhouse gas concentration in the system, the current climate system inertia will still avail global warming [2, 3]. The rapid increase in the atmospheric concentration of CO$_2$ has raised the specter of severe climate change and much effort has gone into understanding the likely scale and implications of global warming. Today, it is generally agreed that doubling of the CO$_2$ in the atmosphere would create serious harm and an often-cited goal for stabilizing CO$_2$ in the atmosphere is 450 ppm, which at current rates of increase, will be breached in about 30 years [4].

These concerns have generated reason for enquiries into the carbon sequestration capacity and carbon storage rate in forests and other associated terrestrial and wetlands ecosystems. With most previous studies concentrating on forest ecosystems and crops, little information still exist on the carbon sequestration potential of wetlands. This is to imply that while wetlands act as the main carbon sink, interests focus on carbon storage studies relating to terrestrial ecosystems. Between 1400 and 1600 petagram (Pg) of carbon are stored as organic matter in typical tropical soils and wetlands; hence serving as important carbon reservoirs. However, limitations on the degree at which soil can act as either source or reservoir of atmospheric CO$_2$ is highly dependent on factors that range from climatic, textural, and topographic conditions to land use practices [5]. Wetland of significant importance is mangrove. It has a capacity of carbon sequestration per unit area of approximately one order of magnitude greater than other systems of wetlands [2] and can store carbon with a minimum emission of greenhouse gases due to inhibition of methanogenesis due to sulfate [6].

Even at several meters of depth, mangrove ecosystems possess the ability to significantly store large amounts of organic carbon. Such property is often influenced because of the presence of an aquifer level near to the surface, just as the high productivity and the low decomposition rate are due to the slow diffusion of oxygen in these

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Abbreviations: KSNP, Kuala Selangor Nature Park; SHD, Sungai Haji Dorani