Background information

The integrity of the mangrove ecosystem is important in supporting the ecosystem and biodiversity functions hence the value for their conservation. Mitigating global climate change is a field of scientific interest with a focus on how ecosystems could provide opportunities for absorbing much of the greenhouse gases (GHGs) released at present. Despite their small extent, vegetated marine ecosystems are now appreciated to sequester significant proportion of the (GHGs). Mangrove forests constitute one of the important blue carbon ecosystems and store large quantities of carbon both in their above and below-ground components as well as in the sediment. However, this carbon risks being released back into the atmosphere when these ecosystems are degraded or their land is converted for other uses. Due to their high carbon density coupled with a high rate of deforestation; there is an increased interest in including mangroves as part of climate change mitigation strategies that would reduce the anthropogenic emission of GHGs. Discussions on incorporating blue carbon ecosystems in the GHGs reduction strategies are ongoing at regular international fora for countries that are signatories to the Kyoto protocol. Kenya, as well as many coastal tropical countries, does not include mangrove carbon in its Nationally Determined Contributions (NDCs). Using the growing knowledge of various policy applications from project findings for blue carbon activities, parties now have an opportunity to include such actions into their revised, and more ambitious, future NDCs. This study aimed at quantifying vegetation carbon stocks of the mangrove forests of Lamu County and its variability across different management blocks. It assessed the forest structure, natural regeneration status and estimated the total vegetation carbon of the mangroves.

Methodology

Using satellite imagery, the project area boundary was defined to cover the Lamu area and restricted to the mangrove ecosystem only. Stratified random sampling was employed and transects selected running perpendicularly from the shoreline. Along each transect, random temporal sampling plots (TSPs) of 400m$^2$ were made and assessed for forest structure, natural regeneration, and vegetation carbon stocks following the adoption and localization of the internationally approved protocol for blue carbon ecosystems. This was supplemented by IPCC’s (2013) national guidelines for greenhouse gases accounting specific for coastal wetlands. A total of 122 plots were sampled in the Northern, Northern Central, and Southern swamps forests. Carbon stocks were assessed in major vegetation carbon pools; Live aboveground biomass carbon, standing dead biomass carbon and belowground biomass carbon, assuming 39% and 50% biomass conversion where appropriate. General allometric equations established by
Komiyama et al. (2005, 2008) were applied to determine both above and below-ground (roots) biomasses from which respective carbon pools were calculated.

**Results**

Five mangrove species were encountered in the three blocks; *A.marina, B.gymnorhiza, C.tagal, R.mucronata, and S.alba*. Northern, Northern central and Southern swamps had 1,702, 2,535 and 3,208 stems ha\(^{-1}\). The standing volume was 200.86, 163.24 and 129.51 m\(^3\)ha\(^{-1}\) in Northern, Northern central and Southern swamps respectively. *Rhizophora mucronata* had the highest importance value in all blocks; 197.1, 157.6 and 182.42 in Northern, Northern central and Southern swamps respectively. Regeneration potential was 7,359, 5,636 and 8,086 saplings ha\(^{-1}\) in Northern, Northern central and Southern swamps respectively. Northern swamps recorded the highest vegetation carbon (157.9 MgCha\(^{-1}\)) while Northern central swamps and Southern swamps registered 128.79 and 128.2 MgCha\(^{-1}\) respectively. The mean average of the biomass carbon was 138.3 ± 16.98 MgCha\(^{-1}\). Extrapolation of these values for the entire Lamu mangrove forests area translates to a mean of 243.54 ± 29.9 MgCha\(^{-1}\). This amount of biomass carbon gives 892.98 tCO\(_2\)e sequestered per hectare.

**Conclusion**

The overall high regeneration in Lamu mangrove forests indicates that the mangrove forests are undergoing normal recruitment and/or recovering from previous anthropogenic disturbances. The estimated carbon stocks begin to fill a huge gap of knowledge regarding this country's contribution to global warming, particularly considering that Lamu County has the largest area coverage of mangroves in Kenya. Findings of this study will greatly contribute to the conservation of biological diversity (BD) Aichi target 15 that focuses on carbon stock enhancement, biodiversity conservation, and ecosystem resilience. In the context of climate change, results of this study will form the baseline data for inclusion of mangroves to Kenyan NDC which will enable the country to conserve mangroves as major carbon sinks contributing directly to Sustainable Development Goal (SDG) 13 (climate action). The improved mangrove management will, in turn, enhance marine productivity in the country, further contributing to SDG 14 (life underwater).

**Keywords:** Mangroves, Vegetation carbon, Blue carbon, Climate change, NDCs, Lamu, Kenya