Role of Plants in CO_2 Sequestration

Title	**Carbon Sequestration by the Terrestrial Soil-Plant System in a Heavily Polluted Area of Riyadh City, Saudi Arabia**
Author Name	J. Mater. Environ. Sci
Journal Name	Khairia M. Al-Qahtani
Year	2018
Volume and Issue	9, 2
Pages	536-543
Abstracts	With the increase of atmospheric carbon dioxide, there is a growing public and scientific concern over the carbon sequestration potential of soil/plant system. The objectives of the present study are: to assess the effect of carbon emission from industrial area, Riyadh City, on the Soil Organic Carbon (SOC) concentration and carbon stored by two plant species Calotropisprocera and Phragmitesaustralis to provide specific information for estimating the carbon sequestration potential of Soil/Plant system of selected polluted area. In the present study, soil organic carbon content ranged from 0.025 g C kg^{-1} at location I associated with Phragmitesaustralis to 0.097 g C kg^{-1} at location III associated with Calotropisprocera. Results showed that leaves of the studied species sequestered more TOC than the corresponding roots . The present study concluded that, both studied plants could be instrumental in formulating efficient strategies related to carbon sequestration and reduction of greenhouse gas emissions in the studied area.
Keywords	carbon sequestration potential; carbon emission; Soil Organic Carbon (SOC); Phragmitesaustralis; Calotropisprocera; greenhouse gas emissions

Title	**Plant chemistry associated dynamic modelling to enhance urban vegetation carbon sequestration potential via bioenergy harvesting**
Author Name	Ka-Lai Chan, Chengyu Dong, Man Sing Wong, Lee-Hyung Kim, Shao-Yuan Leu
Journal Name	Journal of Cleaner Production
Year	2018
Volume and Issue	197
Pages	1084-1094
Abstracts	Urban vegetation is a critical element to achieve sustainable development of highly populated cities. Plants can fix and store carbon in the biomass, and can also be used as an energy source in substituting fossil fuels. In this study, we introduced a new dynamic model to simulate the carbon sequestration potential of urban greening facilities. This model was developed using plant-specific data measured from a typical urban rain garden. Field data and biomass samples were analyzed to calculate the carbon stocks of 7 herb, 7 shrub and 6 tree species. Biomass samples of representative tree species were collected for measurement of tree height, trunk diameter, and total biomass for validating the needed simulation coefficients. The new parameters obtained from chemical composition analyses were included in the model to better describe the bioenergy potentials of various plants species. The proposed model provides a general algorithm which is universally applicable for simulating plant growth and carbon sequestration potential for different plant spices combinations and management practices. The best management practices can be achieved through maximization of growing capacity of plants and bioenergy harvesting. The simulation results suggested that the maximum carbon sequestration potential of the studied urban rain garden can increase from 6.7 kg m^{-2} to 14.7 kg m^{-2} through harvesting and converting the plant-derived biomass into biofuels
Keywords	Urban greening; Carbon sequestration; Rain garden; Biomass; Bioenergy

Title	**Carbon Sequestration under Different Cropping Systems with Different Depth and Its Impact on Climate Change**
Author Name	Bhavya V. P., Anil Kumar S., Alur, A., Shivakumar, K. M. & Shivanna, M.
Journal Name	Int. J. Pure App. Biosci.
Year	2018
Volume and Issue	6, 1
Pages	1612-1616
Abstracts	The main objective of this study was to assess the carbon stocks and carbon dioxide sequestration under different land use systems within the same locality with twenty year old cultivation. The soil samples were collected at a depth of 0-15cm, 15-30cm, 30-50 cm and 50-100 cm from a mango, cashew, rose, vegetable and medicinal and aromatic cropping systems. The study showed that, the magnitude of carbon sequestration is more under mango orchard followed by cashew orchard than annuals crops like rose, medicinal and aromatic and vegetable block. The carbon dioxide sequestration was significantly greater under the perennial crops as compared to annual crops. It was observed that perennial horticulture crops increases the soil organic carbon (SOC) and carbon dioxide storage than annual crops and reduce the carbon emissions to the atmosphere which helps to mitigate the global warming.
Keywords	Carbon storage; Carbon dioxide sequestration; Climate change; Land use systems

Title	Role of Agroforestry in Carbon Sequestration
Author Name	Ankush Kumar, Munish Sharma & Manisha Sharma
Journal Name	Agricultural Extension Journal
Year	2017
Volume and Issue	1, 6
Pages	01-04
Abstracts	Agroforestry is the practice of the purposeful growing of trees and crops, and/or animals, in interacting combinations, for a variety of benefits and services. Agroforestry is a viable alternative to prevent and mitigate climate change. Agroforestry was recognized by IPCC (Intergovernmental Panel on Climate Change) as having high potential for sequestering C as part of climate change mitigation strategies. The average C storage by agroforestry practices has been estimated as 9, 21, 50 and 63 Mg ha^{-1} in semi-arid, sub-humid, humid and temperate regions, respectively. Agroforestry trees improve land cover in agricultural fields in addition to providing C inputs (root biomass, litter and prunings) to the soil. This has often reduced soil erosion, which is crucial process in the soil C dynamics.
Keywords	Agroforestry; climate change; mitigation strategies; soil erosion

Title	**The Role of Haloxylon Plantations in Improving Carbon Sequestration Potential of Sand Dunes of Iran**
Author Name	Loni, Radnezhad, H. Martynova-vankley, Hassanvand, Sadeghi, M.Zaremanesh
Journal Name	Applied Ecology and Environmental Research
Year	2017
Pages	321-333
Abstracts	Rehabilitation of desertified land in semi-arid and arid regions through Haloxylon plantations has a great potential to increase carbon sequestration. In this study, carbon distribution and sequestration were examined in different parts of Haloxylon spp. and depths of soil surface. Afterward, the economic value of carbon sequestration in the Haloxylon plantation was estimated. In order to investigate vegetation variables, a systematic random method with 10 nested plots was applied. Plant properties including diameter at breast height, tree height, height to crown, and the small and large diameters of the crown were measured. Tree and soil sampling was conducted in 10 × 10 m^2 and 5 × 5 m^2 plots, respectively. Soil was sampled at 0-15 and 15-30 cm depths of Haloxylon plantation and control area. Litter were harvested at1 × 1 m^2 plots. Algometric equations and Walkley-Black method were used to determine plant biomass and soil organic carbon sequestration. The results showed that planting Haloxylon increased carbon sequestration by up to 24.46 ton/ha compared to the control area. Economic value of carbon sequestration in the Haloxylon plantation was estimated at $3.74 million. Carbon was mostly sequestrated in the branches and roots. Carbon sequestration in different parts of the plant was calculated as 16.6 ton/ha (54% of total sequestration). Soil organic carbon sequestration was computed as 13.9 ton/ha (46% of total sequestration). Haloxylon species has a high potential for carbon sequestration. Nevertheless, the species used in rehabilitation of desertified lands need to be capable of maintaining other resources, especially water resources.
Keywords	carbon sequestration; economic value; Haloxylon plantation; drylands; sand dunes; Ala region

Title	**Role of specific plant characteristics on thermal and carbon sequestration properties of living walls in tropical climate**
Author Name	Sasima Charoenkit, Suthat Yiemwattana
Journal Name	Building and Environment
Year	2016
Volume and Issue	Volume 115
Pages	67–79
Abstracts	Living walls have the potential to be used as a climate mitigation measure for improving thermal comfort, reducing building energy consumption, and sequestering carbon. Vegetation is an important component of living walls contributing to temperature reduction and carbon sequestration. To investigate the cooling effect and the carbon sequestration potential of vegetation with some specific physical characteristics, an experimental study of living walls located in the tropical climate of Thailand was undertaken for six months covering cold and hot seasons. Three herbaceous plants were selected based on their different leaf sizes including Cuphea hyssopifola H.B.K, Tibouchina urvilleana, and Excoecaria cochinchinensis. These partial results from a six-month monitoring demonstrate the cooling capacity of living walls due to their lower surface and indoor temperatures than the reference wall up to 7.2 °C and 3.3 °C during the daytime in the summer respectively. Differences in the ability to reduce temperature and store carbon are also found between three plant species. Cuphea hyssopifola H.B.K, the plant with the densest foliage, smallest leaves, and woody branches, had the best performance in both aspects.
Keywords	Living walls; Thermal performance; CO_2 sequestration; Vegetation; Tropical climate

Title	Does urban vegetation enhance carbon sequestration?
Author Name	Erik Velasco , Matthias Roth, Leslie Norford, Luisa T. Molina
Journal Name	Landscape and Urban Planning
Year	2016
Volume and Issue	148
Pages	99–107
Abstracts	Many cities are developing policies to promote greenery as a measure to reduce their net greenhouse gas emissions. Studies suggest that urban forests may represent an important carbon reservoir. However, the potential to directly remove carbon dioxide (CO_2) from the atmosphere by urban vegetation is still poorly supported by scientific evidence. Current assessments consider only the carbon accumulated by trees and usually neglect the contribution from soil respiration and the emissions associated with greenery management. Studies in mid-latitude cities suggest that the carbon uptake by urban vegetation is small compared to the magnitude of the anthropogenic emissions. To investigate if the typically evergreen vegetation in (sub)tropical cities has a larger potential for carbon sequestration, the CO_2 flux data from two residential neighborhoods of Singapore and Mexico City were analyzed. Results suggest that (sub) tropical vegetation may act as either an emission source or sink depending on the species and characteristics of the trees and the amount and conditions of pervious surfaces for soil respiration. The biogenic component (vegetation and soil) was found to be a sink of 1 Mg km^{-2} day^{-1} of CO_2 in Mexico City, but an emission source of 0.8 Mg day^{-1} km^{-2} of CO_2 in Singapore. The biogenic contribution to the total CO_2 flux represents −1.4% and 4.4% at both sites, respectively.
Keywords	Carbon sequestration; Urban greenery; Urban forestry; Greenhouse gas emissions; Carbon dioxide; Eddy covariance

Title	**Root carbon inputs under moderately diverse sward and conventional ryegrass-clover pasture: implications for soil carbon sequestration**
Author Name	Samuel Rae McNally & Daniel C. Laughlin & Susanna Rutledge & Mike B. Dodd & Johan Six & Louis A. Schipper
Journal Name	Plant Soil
Year	2015
Volume and Issue	392
Pages	289-299
Abstracts	Background and aims A strategy to increase soil C under pasture-based systems is to increase the root mass inputs or increase rooting depth of plants. Our objective in this study was to measure the seasonal dynamics of root mass and C inputs under two different pasture types (ryegrass-clover vs moderately diverse) that differ in plant diversity and which are commonly used in New Zealand agriculture. Methods This study was carried out on an existing plant diversity field trial containing six replicate paddocks of both moderately-diverse and ryegrass-clover pastures. Soil cores (0-100-200-300 mm sections) were collected seasonally across 1 year and individual root traits assessed from all species. Results The moderately diverse pasture had greater root mass (5320–9350 kg ha^{-1}) than the ryegrass-clover pasture (3810–5700 kg ha^{-1}) for all seasons and had greater root mass lower in the soil profile. A secondary objective demostrated no significant difference in root mass between high and low sugar ryegrass cultivar. Increased root mass results in an estimated increase of C input to the soil of about 1203 kg C ha^{-1} (0–300 mm depth) under the moderately diverse pasture, excluding root exudates. Root trait measurements demonstrated a greater diversity of root traits in the moderately diverse sward compared to the ryegrass-clover pasture. Conclusions Moderately diverse pasture systems offer scope to increase soil C under grazed pastures through increased root mass inputs and rooting depth.
Keywords	Living walls; Thermal performance; CO_2 sequestration; Vegetation; Tropical climate

Title	**Predicting long-term carbon sequestration in response to CO_2 enrichment: How and why do current ecosystem models differ?**
Author Name	Anthony P. Walker,Sönke Zaehle,Belinda E. Medlyn, Martin G. De Kauwe,Shinichi Asao,Thomas Hickler,William Parton,Daniel M. Ricciuto,Ying-Ping Wang,David Wårlind,Richard J. Norby
Journal Name	Global biogiochemichal cycles
Year	2015
Volume and Issue	29,4
Pages	476-495
Abstracts	Large uncertainty exists in model projections of the land carbon (C) sink response to increasing atmospheric CO_2. Free-Air CO_2 Enrichment (FACE) experiments lasting a decade or more have investigated ecosystem responses to a step change in atmospheric CO_2 concentration. To interpret FACE results in the context of gradual increases in atmospheric CO_2 over decades to centuries, we used a suite of seven models to simulate the Duke and Oak Ridge FACE experiments extended for 300 years of CO_2 enrichment. We also determine key modeling assumptions that drive divergent projections of terrestrial C uptake and evaluate whether these assumptions can be constrained by experimental evidence. All models simulated increased terrestrial C pools resulting from CO_2 enrichment, though there was substantial variability in quasi-equilibrium C sequestration and rates of change. In two of two models that assume that plant nitrogen (N) uptake is solely a function of soil N supply, the net primary production response to elevated CO_2 became progressively N limited. In four of five models that assume that N uptake is a function of both soil N supply and plant N demand, elevated CO_2 led to reduced ecosystem N losses and thus progressively relaxed nitrogen limitation. Many allocation assumptions resulted in increased wood allocation relative to leaves and roots which reduced the vegetation turnover rate and increased C sequestration. In addition, self-thinning assumptions had a substantial impact on C sequestration in two models. Accurate representation of N process dynamics (in particular N uptake), allocation, and forest self-thinning is key to minimizing uncertainty in projections of future C sequestration in response to elevated atmospheric CO_2.
Keywords	Grazed pastures; Root mass; Soil C; Moderately diverse pasture; Ryegrass-clover

Title	**Contemporary Rates of Carbon Sequestration Through Vertical Accretion of Sediments in Mangrove Forests and Saltmarshes of South East Queensland, Australia.**
Author Name	Catherine E. Lovelock & Maria Fernanda Adame & Vicki Bennion & Matthew Hayes & Julian O'Mara & Ruth Reef & Nadia S. Santini
Journal Name	Estuaries and Coast
Year	2014
Volume and Issue	Volume 37
Pages	763–771
Abstracts	Mangrove forests and saltmarshes are important habitats for carbon (C) sequestration in the coastal zone but variation in rates of C sequestration and the factors controlling sequestration are poorly understood. We assessed C sequestration in Moreton Bay, South East Queensland in mangrove forests and tidal marshes that span a range of environmental settings and plant communities, including mangrove forests and tidal marshes on the oligotrophic sand islands of the eastern side of Moreton Bay and on the nutrient enriched, western side of the bay adjacent to the city of Brisbane. We found that rates of C sequestration in sediments were similar among mangrove forests over the bay, despite large differences in the C density of sediments, because of different rates of vertical accretion of sediments. The C sequestration on the oligotrophic sand island tidal marshes, dominated by Juncus kraussii, had the highest rate of C sequestration in the bay while the western saltmarshes, which were dominated by Sarcocornia quinqueflora, had the lowest rate of C sequestration. Our data indicate C sequestration varies among different tidal wetland plant community types, due to variation in sediment characteristics and rates of sediment accretion over time.
Keywords	Avicennia marina; Rod surface elevation tables; Sediment nutrients; Carbon/phosphorus ratio

Title	**Faster Decomposition Under Increased Atmospheric CO_2 Limits Soil Carbon Storage**
Author Name	Kees Jan van Groenigen, Xuan Qi, Craig W. Osenberg, Yiqi Luo, , Bruce A. Hungate
Journal Name	Science
Year	2014
Volume and Issue	344(6183)
Pages	508-509
Abstracts	Soils contain the largest pool of terrestrial organic carbon and are a major source of atmospheric carbon dioxide.Thus, they may play a key role in modulating climate change. Rising atmospheric CO_2 is expected to stimulate plant growth and soil carbon input but may also alter microbial decomposition.The combined effect of these responses on long term carbon storage is unclear. Combining meta - analysis with data assimilation,we show that atmospheric CO_2 enrichment stimulates both the input (+19.8) and the turn over of carbon in soil(+16.5%). The increase in soil carbon turn over with rising CO_2 leads to lower equilibrium soil carbon stocks than expected from the rise in soil carbon input alone, indicating that it is a general mechanism limiting carbon general mechanism limiting carbon accumulation in soil.
Keywords	Terrestrial organic carbon; Microbial decomposition