清大樹木減碳效益分析

近來校務急速發展，合校後二校區師生往來頻繁人數增加，能使用的空間越來越少，本校師生對綠資源之需求愈益殷切。因此為減緩全球氣候變遷，降低與管理溫室氣體之排放成為首要之務，本校以樹木保育行動落實，減緩溫室效應，善盡保護地球之責任，朝向永續「水木清華」校園的目標努力，建構安全、低碳、舒適的優質學習、教學與研究環境

樹木可以吸收我們校園中產生的二氧化碳，進行光合作用釋放新鮮氧氣、產生陰離子、散發芬多精，是減緩溫室效應及淨化空氣的大功臣！另外，樹木的葉面可以黏著懸浮微粒，所以也有濾浮游塵、淨化空氣的作用。根據研究指出，樹木進行光合作用釋放新鮮氧氣量，林地二氧化碳吸收量可達每公頃 7.45 至 14.9 公噸(註一)，樹葉沉積浮游塵的最大量可達每公頃 30 至 68 公噸(註二)，經統計本校樹木數量約 1 萬 1 千餘株，綠覆面積約在 40 公頃以上，如換算將可彰顯減碳的效益為每年約 590 噸(約 1.5 座大安森林公園)，減輕空氣中懸浮微粒效能則為每年 2700 噸。

樹木保育方面，當褐根病菌(*Phellinus noxius*)入侵樹木的根部組織，便會開始大肆破壞，造成木材組織的腐朽，原本堅固的根變得脆弱腐敗，影響根系吸收土壤中的養分導致凋萎死亡；也因為支撐力下降而容易倒伏，在外觀不易察覺下，遇強風豪雨無預警傾倒，可能壓壞房屋與車輛、阻礙交通，如果壓到行進中的行人、車輛，後果更是不堪設想，形成校園安全隱憂。因此本校非常重視極具威脅性褐根病樹木之防治，於 2020 年 3 月進行校園主要道路、人行道與停車場旁樹木健康檢查與風險評估，經檢查結果確診罹患褐根病有 26 棵，樹頭 7 個，鄰近褐根病病樹的有 46 棵，並積極編列

2021 年專案預算 157 萬元進行全校樹木褐根病防治；另本校經費亦逐年編列預算，進行植栽病蟲害防治及樹木修剪維護等美化工作，其中松材線蟲及松毛蟲防治每年預算約 50 萬，樹木修剪維護部分 2018 年起至 2021 年之預算皆為 240 萬元；針對對本校意義重大之梅園，亦定期對園內之梅樹、龍柏進行剪枝修剪、施肥及病蟲害防治，以維護校園樹木健康及生態永續發展。

註一：資訊來源：林務局「減碳森活綠動 99」網站資料，以單位面積林地固碳係數 7.45~14.9tonCO2e/ha/yr，大安森林公園每年的碳吸收量＝389 噸

註二:資訊來源：屏東縣政府環保局樹木銀行

http://www.green99.com.tw/treebank/tree-6.html

Analysis of the Benefits of Carbon Reduction by Trees in Tsing-hua University

With the rapid development of campus affairs recently, the frequent exchanges of teachers and students between the two campuses of Tsing-hua University have increased after the merger, and the space available for use has reduced. The demand for green resources by the teachers and students of our campus has become increasingly intense. Therefore, in order to mitigate global climate change and reduce and manage greenhouse gas emissions as a top priority, the campusis implementing tree conservation actions to reduce the greenhouse effect, to fulfill its responsibility to protect the earth, and to strive toward the goal of a sustainable "Shuimu Tsinghua" campus. Construct a safe, low-carbon, and comfortable high-quality learning, teaching, and research environment.

Trees can absorb the carbon dioxide produced in our campus, perform photosynthesis to release fresh oxygen, produce anions, and emit phenodrine. Trees are a significant contributor to slowing down the greenhouse effect and purifying the air. In addition, suspended particulatesare attached to the leaves of trees; therefore, trees also perform the function of filtering floating dust and purifying the air. A significant amount of fresh oxygen is released by trees during photosynthesis. Moreover, the carbon dioxide absorption of forest land can reach 7.45 to 14.9 metric tons per hectare (Note 1), and the maximum amount of floating dust deposited by leaves can reach 30 to 68 metric tons per hectare (Note 2). Statistically, the number of trees on the campus is approximately 11,000, and the green cover area is approximately40 hectares or more. Estimates show that the carbon reduction is approximately 590 tons (about 1.5 times that of Da'an Forest Park) per year. The effect of reducing suspended particulates in the air is 2,700 tons per year.

In terms of tree conservation, when the fungus *Phellinus noxius* invades the root tissue, it begins to negatively impact the tree, causing decay of wood tissue. The originally strong root becomes fragile and corrupt, affecting the root system and nutrient absorption from the soil

and causing withering and death. It is also likely that the tree would fall because of the decreased support from the roots. As this cannot be easily detected, the tree may fall without warning during strong wind and heavy rain, which may damage houses and vehicles and obstruct traffic. If the tree falls on pedestrians and vehicles in motion, the consequences will be even more disastrous, raising campus security concerns. Therefore, the campus attaches great importance to the prevention and control of the most threatening brown root rot disease in trees. In March 2020, health inspections and risk assessments of trees along the main roads, sidewalks, and parking lots of the campus were conducted. Based on the inspection results, 26 trees were diagnosed with brown root rot disease. There are 7 trees with the disease adjacent to 46 trees, and a 2021 project budget of 1.57 million dollars has been actively compiled for the brown root rot disease prevention and control on the campus. In addition, the campus budgets annually for planting, disease and insect pest control, and tree pruning and maintenance. The beautification work includes the annual budget for pine wood nematode and pine caterpillar control of approximately 500,000 yuan, and the budget for tree pruning and maintenance from 2018 to 2021 is 2.4 million yuan. Additionally, it funds the plum garden, which is of great significance to the campus. Pruning, fertilization, and pest control of trees and cypresses are carried out to maintain the health of the campus trees and for the sustainable development of ecology.

Note 1: Information source: Information on the "Carbon Reduction Forest Green Activity 99" website of the Forest Service Bureau, based on the carbon sequestration coefficient per unit area of forest land 7.45–14.9tonCO2e/ha/yr, the annual carbon absorption of Da'an Forest Park = 389 tons

Note 2: Source of information: Tree Bank, Environmental Protection Bureau, Pingtung County Government http://www.green99.com.tw/treebank/tree-6.html