Estimation of Carbon Uptake of Seoul City Street Trees in Seoul and Plans for Increase Carbon Uptake by Improving Species

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Introduction

S.Korea has reported in G7 summit conference held in 2008 about a goal of decreasing the emission of green house gases compared to the BAU up to 2020. In addition, legal grounds were established in the aspect of source for absorbing the carbon as the law in maintaining and increasing the source of absorbing carbon was passed for the first time as an exclusive regulation on the source of absorbing the carbon in 2013 and also low-carbon green growth law in 2010. However, there is no legal ground in managing the street trees as a source of absorbing carbon in the laws in maintaining and improving the source of absorbing carbon. Street trees serve as a role of replacing the green areas in the city and do not require the land only for planting trees since they are planted alongside the road. Therefore, the number of trees increases as the city area is extended. Therefore, it is needed to manage street trees as a source of absorbing carbon as the urbanization is proceeded further.

Experiment

Cherry, Ginkgo, Zelkova, Platanus occidentalis, Maple, Metasequoia, Locust trees, Tulip trees, and Pine trees were selected in order to calculate the absorption of carbon dioxide from street trees in Seoul estimating the biomass, the amount of carbon saved, and annual absorption amount of carbon dioxide. Species other than the representative types were replaced with species with similar figures of leaves, roots, or branches. In case that there was no replacement, average value was used.[1]
There are total 25 administrative districts in Seoul as of 2013 in 605.2km2, and the distance of extended road except for highway was 8,197,932m. The total area of the road was 83,610,749m2, and urbanized area was 374.55km2. Urbanized road area was 83.61km2, and the urbanized area proportion was 60.5%. Lastly, the street ratio was turned out to be 22.32%.[2]
The planting distance of street trees in Seoul was 1,851,180m, the number of lines for street trees was 1,287, and the number of total street trees was 284,498 as of 2013. In addition, there were total 46 species of trees being planted. Among them, ginkgo had the highest number of trees, 114,198, that were planted taking up 40.1% among the entire trees. Average planting distance was 6.51m.

Table 1 Absorption rate of carbon dioxide as well as biomass, increasing rate, and amount carbon saved of representative species of street trees

Specification	Biomass (kg/tree)		Increasing rate of biomass (kg/tree/y)		Amount of carbon saved (kg C/tree)		Absorption rate of CO_2 ($kgCO_2$/tree/y)	
	Average	Average error	Average	Average error	Average	Average error	Average	Average error
Cherry	334.7	96.3	14.7	3.2	167.4	48.1	26.9	5.9
Ginkgo	300.4	46.2	19.3	3.3	150.2	23.1	35.4	6.1
Zelkova	388.4	67.3	30.3	3.4	194.2	33.6	33.7	6.1
Platanus occidentalis	723.2	129.6	18.4	3.3	361.6	64.8	55.6	6.3
Maple	116.3	24.4	11.2	2.9	58.1	12.2	20.5	5.3
Metasequoia	630.5	49.8	38.0	3.6	315.2	24.9	69.6	6.7
Locust trees	247.2	46.0	17.7	3.9	123.6	23.0	32.5	7.1
Tulip trees	690.0	117.9	55.6	11.7	345.0	59.0	101.9	21.5
Pine trees	95.0	10.8	4.0	0.5	47.5	5.4	7.3	0.9
Average	391.7	65.4	23.2	4	195.9	32.7	42.6	7.3

(Source: Plans for calculating the absorption amount of carbon dioxide of trees in cities and for improving the absorption effect 2009 Gyeonggi Development Institute, Eunjin Park)

Results & Discussions

The result are as followings plugging the quantity of species of street trees in Seoul to the amount of absorption in each of the species, 120,097 ton of biomass, 60,049.8ton of carbon amount being saved, and 11,294t CO2/year of the absorbed amount of carbon dioxide were calculated.
The increasing rate was estimated by using street ratio in order to calculate the expected absorption amount in 2022. Street ratio is the proportion of road in the urbanized area. Street trees are most likely planted alongside the road in urbanized areas that the street ratio and the quantity of street trees are closely related. The street ratio mentioned on the road statistics in Seoul in 2022 is 23.13%. Assuming that the street trees are increasing in the same rate, the number of street trees in Seoul was expected to be 294,823. The distance of planting distance was calculated to be 1,918,360m along with the annual absorption amount of carbon dioxide estimated to be 11,704tCO2/year.
Plans for improving the annual absorption amount of carbon dioxide were derived based on the expected amount of absorption.
First of all, it is to increase the absorption amount of carbon dioxide on an annual basis by increasing the number of planted street trees by controlling the planting distance of street trees. If adjusting the current planting distance 6.51m to the legally minimum distance of 6m, the number of street trees will be increased to 319,726. If calculating the annual absorption amount of carbon dioxide with an increased number of representative street trees, it was derived to be 12,692.7tCO2/year, and it was calculated to be 14,241.7tCO2/year if assuming that the tulip trees, the one with high absorption amount, were to be planted.
Secondly, it is to increase the absorption amount by changing the species of trees. Tulip trees represent the highest absorption amount of carbon dioxide in a year among all the representative species of trees, and it is calculated to be 101.9kgCO2/tree/year. The number of tulip trees planted up to 2013 was 874 that were only about 0.31% of the entire trees. If increasing the proportion of tulip trees up to 30% by 2022, the annual absorption amount of carbon dioxide is calculated to be 17804.4tCO2/year. It is turned out to be expected by 5111.7tCO2/year compared to the amount without improvement.

Conclusions

Most of absorption of carbon dioxide is not economical compared to other means of reduction and is also not realized rapidly with the effect. The amount of carbon dioxide absorbed by street trees is very small compared to the entire amount of carbon dioxide emitted from the entire city or the whole forest. However, it is feasible to acquire the source of absorption without assigning the land separately and also brings an effect of improving the environment in city. Therefore, it seems that a broad viewpoint is required to manage it. Trees are almost the one and only UNFCCC-approved source of absorbing green-house gases. Acquiring the source of absorbing carbon dioxide is as important as reducing the amount of it through the technology development.

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