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VIEWPOINT

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Increasing Forest Carbon Sequestration through Cooperation and Shared Strategies between China and the United States

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China and the United States are the world's top CO_2 emitters. Both countries also harbor extensive forests that offset a substantial fraction of their CO_2 emissions and have the potential to offset considerably more. U.S. forests sequestered 236 Tg C yr^{-1} from 2000 to 2005, balancing 12−19% of the country's CO_2 emissions.[1] China's forests took up 96 Tg C yr^{-1} from 1994 to 2003,[2] equivalent to 8.5% of China's CO_2 emissions in 2003. These rates of CO_2 sequestration were contributed by each nation's forestry programs but have not reached their full potential.[1,3] To date, the two countries have taken contrasting approaches to forest management. We propose that each country could increase carbon sequestration dramatically by adopting the most successful aspects of the other country's program.

The U.S. and China have both undergone extensive forest exploitation and recovery, but the processes have differed in temporal scale and pace. In the past century, U.S. policies helped decrease rates of deforestation and promote forest restoration across the country. Most U.S. forestry programs were initiated or reorganized in 1978, in an effort to provide technical and financial assistance to forest landowners to promote forest restoration, protection, and management. In comparison, five of China's six national forestry programs were initiated in 2000−2001.[4] China has spent $90 billion on these programs over the past decade,[4] much more than the U.S. has spent on its national forestry programs.

Forest area in the U.S. has remained relatively stable, but unit-area and total growing stocks have increased. In contrast, while China's total forest area and growing stock have increased, the unit-area growing stock declined from 2002/2003 to 2007/2008 (Figure 1). These differences suggest that increases in forest productivity are driving CO_2 sequestration in the U.S., while expansion of forest area drives CO_2 sequestration in China. In both countries forest harvesting has declined and forest-area conservation has expanded, representing common forestry dynamics contributing to CO_2 sequestration between 2002/2003 and 2007/2008 (Figure 1).

Most of China's forests grow in climate zones similar to those of U.S. forests, and potential sequestration rates in forests of both countries could be similar. If China followed the U.S. approach to forest ecosystem management and soil conservation, it could increase forest carbon sequestration substantially. Increasing China's average forest carbon sequestration rate (currently 0.55 kg C ha^{-1} yr^{-1}) to the same level as in the U.S. (0.78 kg C ha^{-1} yr^{-1}) through increasing forest productivity would boost China's forest carbon sequestration from 96 to 152 Tg C yr^{-1} without requiring additional forestland area (Figure 1).

Forest fires in the U.S. released about 293 Tg CO_2 yr^{-1} in 2002−2006, while those in China emitted only 11 Tg CO_2 yr^{-1}, or 4% as much[2] (Figure 1). China has reduced human-induced forest fires to a minimum through fire-prevention efforts of the National Forest Fire Prevention Office, which is administratively accountable for all wildfires. Should the U.S. government provide more administrative and financial support, it would be possible to reduce forest fires in the U.S. by increasing the use of prescribed burning and mechanical treatment of forest fuels.[1] If forest fires in the U.S. were reduced to the same level as in China, an unlikely scenario, sequestration would increase by 282 Tg CO_2 yr^{-1} in the U.S. (Figure 1).

China has invested considerably more in afforestation than the U.S. has (Figure 1). China has also implemented strict forest laws to prevent forestland loss due to land use change. As a result, both natural and man-made forests in China have increased in area, whereas U.S. natural forest area has declined (Figure 1). Another

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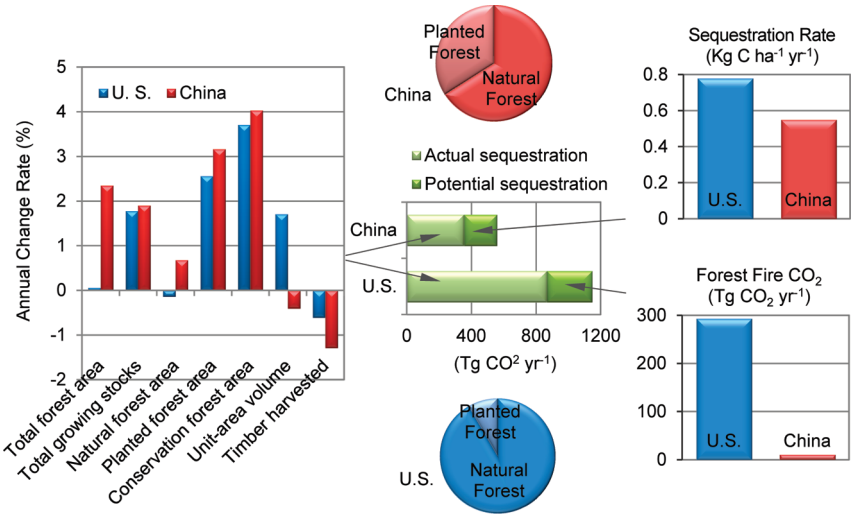

Figure 1. China−U.S. comparisons in annual change rates of seven forest variables, planted vs natural forest area ratio, actual vs potential carbon sequestrations, forest fire CO_2 emission, and forest sequestration rate.[1,2,5]

difference is that China has planted extensive areas with genetically modified (GM) trees, while the U.S. continues to debate developing biomass- and bioenergy-centered forestry programs. This distinction reflects different management structures. China's forest management structure can change directions rapidly for practical reasons but has not led to a stable increase in productivity;[3] U.S. forest management is more consistent and private-sector driven, but it also tends to respond more slowly to changes in policy objectives. China's afforestation experience with transgenic trees provides a living laboratory for studying the benefits for productivity and the risks for possible gene transfer.

China participated in the Kyoto Protocol, but did not implement carbon banking for China's forests, though carbon-sequestration office branches have been established and forestry expansion plans have been announced by the Chinese government. The United Nations' Reducing Emissions from Deforestation and Degradation (REDD+) program, a collaborative initiative for offsetting CO_2 emissions through changes in forest management, has not yet been supported *financially* by China. In contrast, the U.S. committed $1 billion to REDD in developing countries over the next three years. The two largest economies in the world should invest more in forest carbon sequestration and in combating CO_2 emissions domestically and globally. The U.S. has made forest inventory data publically available, whereas China does not yet release forest inventory data. Making these data available online would enable researchers around the world to provide useful analyses that could promote forestry and forest growth in China.

Private foresters in the U.S. can choose how to manage their land, which makes forest stocking less predictable, but highly responsive to incentive systems. In contrast, China's land-leasing system allows the government to control land use change, but does not encourage farmers to manage for maximum carbon stocks over the long-term. As a result, forest management is primarily market-driven in the U.S., but not so in China. China's forest timber production and forest carbon sequestration are also controlled by the top-down governmental system. Chinese forestry could adapt U.S. experience in how to practice sustainable forestry in a more market-based economy.

Overall, we cannot afford to overlook the role of forests as an important carbon sink. As the world's top CO_2 emitters, China and the U.S. have both practical and ethical reasons to promote carbon sequestration. An inexpensive path toward this goal is to facilitate greater sharing of experience and knowledge among the nations' forestry programs.

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