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Viewpoint

The potential and challenges of sequestering carbon and generating other services in China's forest ecosystems

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Author's Viewpoint

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In his speech at the U.N. Climate Summit on September 22, 2009, President Hu declared that China would combat climate change by planting more trees, in addition to efforts of energy conservation and efficiency enhancement, increased use of renewable and nuclear energies, and adoption of climate-friendly technologies. Specifically, he committed to expanding the country's forest area by 40 million hectares (ha) and stocking volume by 1.3 billion m^3 from 2006 to 2020. It is necessary for the international community to assess whether this represents a major step forward, what the potential of China's forests is in sequestering carbon and providing other ecosystem services, and how this potential may be achieved.

According to the 2005 Global Forest Resources Assessment (FRA), China had a forest area of 197.3 million ha, carrying a stocking volume of 13.26 billion m^3 (*1*). Compared to its status in 1990, China's forest area gained by over 40 million ha and stocking volume by 2.77 billion m^3 in 2005 (Figure 1). Given one cubic meter of stocking volume is equivalent to 1.05 tons of biomass—above- and below-ground as well as deadwood—and a biomass-to-carbon conversion factor of 0.5, this volume increment amounts to a woody biomass of 2.91 billion tons and a carbon stock of 1.45 billion tons (*1*). This stock is slightly below the carbon amount of China's emissions from fossil fuel combustion in 2005 (*2*). As a whole, China's forests stored about 7 billion tons of carbon in 2005 (*1*).

While an ambitious goal, it is very likely that China will be able to add another 40 million ha of forests over the 15 year period (2006−2020). Since the turn of the century, China has been undertaking several forest-oriented, large ecological restoration and resource expansion programs (*3*). The government claims that the implementation of these programs is "a leap forward development" in China's forestry (*1*, p.11).

By 2005, there had already been an area of 14.2 million ha afforested but remaining unstocked, most of which should have become well stocked by now and thus can be counted as a large addition to the forest area (*1*). Considering the recent efforts of accelerated tree planting (*3*), it is not hard to infer that probably half of the 40 million ha target has been completed. Further, there still are 33.6 million ha classified as "forest-suitable land" available for afforestation and natural regeneration; and since 1990, natural forests, plantations, and shrub lands have all gained in acreage (*1*). Thus, all the evidence suggests that China will be able to accomplish its target of forest area expansion by 2020.

However, it seems that the proposed volume gain of 1.3 billion m^3 over the 15-year period represents only a modest, and indeed conservative, gain. First, this figure is less than half of the volume increment for the period of 1990−2005.

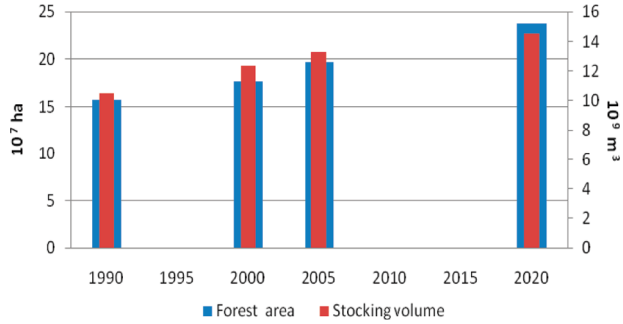

FIGURE 1. Forest area and stocking volume of China. Note: Data for 1990, 2000, and 2005 came from the FRA Country Reports: China (*1*); data for 2020 were derived according to the Chinese government's commitments of resource expansion to combat climate change, announced by President Hu.

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Second, it is only a 9.8% increase over the volume of 2005, carrying a carbon stock of 683 million tons in woody biomass. More important, given China's continued rapid economic growth and the possible carbon intensity of its economy—the amount of CO_2 produced for each unit of economic output—this amount of carbon sequestration may not constitute a significant offset.

A consensus is that China's Gross Domestic Product will grow at an annual rate of 8% until 2020. Meanwhile, the government has just announced a reduction in emissions intensity by 40−45% by 2020, compared to the level of 2005. We have estimated that China's cumulative carbon emissions from fossil fuel combustion during 2006−2020 will be around 32.7−34.4 billion tons, with a baseline of 1.6 billion tons in 2005 (*2*). As such, the official target of an additional carbon stock of 683 million tons in woody biomass is only about 2% of the country's cumulative CO_2 emissions for the same period, even with emissions from other greenhouse gases (methane, nitrous oxide, etc.) being excluded. Clearly, that can hardly be viewed as a major step in curbing its emissions.

The question then is whether China's forests have a greater potential of sequestering carbon and generating other ecosystem services. Our answer is "Yes." The 2005 forest stocking level of 67.2 m^3/ha is very low, compared to either the international average of 110 m^3/ha (*1*), or the production capacity of the majority of forestlands in the country. While forests in the northwest of the country normally do not support a high stocking level due to moisture constraint, those in the northeast and much of the south can support high stocking levels.

Because of China's obsession with acreage expansion, extensive degradation of existing stands, and neglect of effective forest management, however, the stocking levels of both natural and plantation forests are disappointingly low (*1*). In the southern provinces where plantation forests are concentrated, the stocking level is mostly in the range of 30−50 m^3/ha. In the northeast, a major natural forest region, it is below 80 m^3/ha in the two large provinces (Inner Mongolia and Heilongjiang). These figures point to a great potential for increasing the stocking levels of China's forests as well as the country's failure to improve its forest quality and productivity.

If the overall stocking level can increase 10 m^3/ha from 67.2 m^3/ha in 2005 to 77.0 m^3/ha in 2020, the total volume will reach 18.27 billion m^3/ha, with a net gain of 5.02 billion m^3—almost 4 times the government's goal. This volume can absorb close to 9% of the cumulative CO_2 emissions during 2006−2020. Notice, though, that this stocking level is still below the average for East Asia (81 m^3/ha (*1*)). In contrast, given the area and volume increases proposed by President Hu, the stocking level would decline to 61.34 m^3/ha by that time!

Some may feel that because over $^2/_3$ of China's forests are categorized as young or midaged stands, the lower stocking level is not necessarily unreasonable. However, younger stands tend to have higher growth rates. Unfortunately, the mean growth rate of China's forests is only 3.55 m^3/ha/yr (*1*). If that can be raised to 5 m^3/ha/yr, an additional annual increment of over 340 million m^3 will result. It can be further argued that the tremendous area expansion will make it harder to increase the stocking level, particularly in the not-so-distant future. Nonetheless, it is more relevant to focus on the increase of forest stock, as far as carbon sequestration and the generation of other ecosystem services are concerned. After all, expansion in forest area, even if a significant one, does not mean much without a sensible gain in stocking level.

Therefore, China should emphasize the efficiency and productivity of its forestry. To that end, silvicultural practices must be fundamentally improved in terms of site and species selection, planting density, quality, and timing, competition control, and thinning (*4*). So far, management activities following tree planting and regeneration, such as tending and thinning, have not been fully incorporated into the ecological restoration and resource expansion programs.

Moreover, the issue of poor stand quality has been confounded by the high-density and rush plantings, mainly driven by farmers' desire to meet the government's requirement for adequate survivals as early as they can to be eligible for receiving subsidies (*3*). Consequently, the growth rates have been low, and in many cases the canopy has not closed for a long time; and stand yield and vigor, let alone ecosystem functionality, are unsatisfactory (*4*). Additionally, studies have shown that once the public subsidy ends, some farmers will likely reconvert their retired cropland to farming, leading to new deforestation and land degradation (*3*).

To improve silvicultural practices and the quality of stand establishment and forest management, the lagging public investment in capacity building, technical training, and extension service ought to be reversed. Nonetheless, it is unrealistic to rely on central government investments alone; local public and private entities must play a much more active part. Without adequate bottom-up initiatives and local engagement, people tend not to plant or properly maintain trees (*5*). Likewise, without clear responsibilities and rewards, business enterprises, state employees, and rural households will not perform effectively in forest protection and management. So far, however, the authorities have opted too often for administrative campaigns and failed to realize the role of incentives as well as the importance of contracting, open bidding, and other market-based mechanisms for carrying out various operations (*3*).

Finally, it is also critical to institute a meaningful monitoring and assessment system. In this regard, the lack of transparency and adequate procedures and no separation of monitoring from program implementation are major problems that the forestry administration faces, while weak coordination and collaboration are impediments to the science and research community (*3*). Moreover, the inadequacy of scientific advisory and stakeholder representation is a common issue across all of the monitoring and assessment activities.

In short, China's forests can act as a significant carbon sink and provider of other ecosystem services. To realize its potential, however, China must focus on improving its forest quality and productivity by transforming its sivilcultural practices and forest governance.

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