Combating Climate Change: What Will China's Forestry Industry Do?

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Climate change is significantly affecting our planet (Kerr 2007). Global agreements and sustained action to mitigate climate change are urgently needed (King 2004). It is well known that forests play a large role in the global carbon cycle, and thus may be of prime importance in efforts to curb climate change. Carbon storage in existing forests, carbon emissions from deforestation, and carbon sequestration through afforestation and reforestation are important issues for land use policy makers. In 2000 the Intergovernmental Panel on Climate Change (IPCC) estimated that the global carbon stock present in terrestrial ecosystems is about 2,477 Gt, of which 1,146 Gt or 46.3% is stored in forests (Watson et al. 2000). However, the terrestrial global carbon stock is constantly decreasing due to large-scale deforestation at a rate which cannot be offset by current afforestation and reforestation rates (Watson et al. 2000). Therefore, higher afforestation and reforestation rates and a lower deforestation rate must be achieved.

As a responsible developing country which has the largest area of artificial forest in the world, China's afforestation and reforestation activities have, to an extent, offset the negative impacts of deforestation in the world (FAO 2005). In China, between 1980 and 2005, approximately 3.06 billion tons of CO₂ was sequestered by afforestation activities, 1.62 tons of CO₂ was sequestered by forest management, and CO₂ emissions were reduced by 0.43 ton due to a decrease in deforestation (Commission of Development and Reform, China Government 2007).

PATHWAYS AND POTENTIAL WAYS IN WHICH FORESTRY CAN MITIGATE CLIMATE CHANGE

In forestry management, mitigation of climate change can be accomplished via several routes: increasing carbon sinks, decreasing carbon emissions, increasing carbon storage in wood products, and developing alternative biomass energy. In China, six aspects of forestry management have achievable potential: (a) Increase carbon sink storage by increasing forest area through afforestation. Compared with developed countries and some developing countries, forest coverage in China is relatively low. There are 57 million ha of mountainous areas available for afforestation, 54 million ha of sandy land available for afforestation, and many areas of steep sloping cultivated land with a gradient of >25° and other unused land all available for afforestation. The Central Government plans to increase the current 18.2% of forest coverage to more than 26% by the year 2050 (Lei 2005). (b) Increase carbon sink storage through improvement in quality of existing forests. The average volume of existing forest is approximately 84 cubic meter per ha, and the average annual growth rate is about 3.55 cubic meter. The majority of forest stands are low biomass plantations and secondary forests. Therefore, it has been estimated that carbon storage in existing forests is only approximately 44.3% of the potential storage amount (State Forestry Administration (SFA) 2005). (c) Reduce carbon emissions through a forest protection strategy. Deforestation activities must be strictly prohibited as it has been estimated that about 1 million ha forest has been illegally clearfelled. Forest harvesting activities must be scientifically managed to effectively protect understory vegetation and forest soil. The frequency and spread of forest fires, forest diseases and

pests must be controlled. (d) Reduce carbon emissions through the protection of wetlands and prevention of soil erosion in forests. (e) Reduce carbon emissions through the development of alternative biomass energy sources. (f) Increase wood product storage through different timber use methods and storage time periods.

LONGER-TERM FORESTRY GOALS AIMED AT MITIGATING CLIMATE CHANGE

In 2007, the State Council enacted ‘China’s Action Program to Deal with Climate Change’ to actively implement the recommendations of the United Nations Framework Convention on Climate Change (UNFCCC). In response to this program, a new plan called ‘China’s Forestry Action Plan to Deal with Climate Change’ was formulated on Nov. 6th, 2009. This plan established a framework for next-step forestry goals and main forestry activities in key fields aiming to mitigate climate change (State Forestry Administration (SFA) 2009).

In the action plan, three sequential goals were determined as (a) Up to 2010: annual mean afforestation area (including mountains for forest restoration) will be more than 4 million ha; nationwide forest coverage will be 20%; forest storage volume will be 13.2 billion cubic meters; key regions in the upper and middle reaches of the Yellow River and the Yangtze River, which have harsh environments and experience soil and water loss and areas affected by serious desertification, will be basically controlled; the protected area of national key commonwealth forest will be increased to 51 million ha; 50% of natural wetland to be protected effectively; 50% of seeds and seedlings used for afforestation will be of high quality. Through the attainment of these goals, there will be an increase in the sequestration of carbon by forests. (b) From 2011 to 2020: the annual mean afforestation area (including mountains for forest restoration) will be more than 5 million ha; nationwide forest coverage will be 23%; forest storage volume will be 14 billion cubic meters; more than 50% of controllable sandy desertified land will be controlled; the protected area of national key commonwealth forest will increase to 110 million ha; more than 60% of natural wetland will be protected effectively; 65% of seeds and seedlings for afforestation will be high quality. At the end of year 2020, when compared with the figures of 2005, the forested area should have increased by 40 million ha and forest storage volume increased by 1.3 billion cubic meters. The forest carbon sequestration capacity should have also increased. (c) Up to 2050: net increase in forest area will be 47 million ha compared with the amount in 2020, nationwide forest coverage should be equal to or greater than 26%; typical ecosystems be better protected; all controllable sandified land to be controlled at a basic level; all the natural

wetlands should be protected, restored, and managed wisely; 100% of seeds and seedlings for afforestation should be of high quality. At this stage the focus of forestry should be on sustainable forest management, and the forest carbon storage capacity relatively stable. In addition, some key fields and associated forestry activities addressing the issues of climate change are listed in this action plan as Table 1 (State Forestry Administration (SFA) 2009).

MORE KEY ASPECTS NEED TO BE CONSIDERED

There is no doubt that the new forestry action plan is an exciting and prospective blueprint with an expected global contribution to carbon sequestration. However, we note that several key aspects are not fully dealt with in respect to the management of a forest as a carbon sink. These aspects are discussed briefly as follows:

- (a) Tree plantations are able to sequester significant amounts of carbon, but this requires a large amount of water consumption (Calder 2007). The average stream flow losses for 10- to 20-year-old plantations are 227 mm/year or 52% of stream flow globally, which cannot be offset by climate change feedback (Jackson et al. 2005). As a water-scarce country, China is facing a water resource crisis in the twenty-first century, particularly in northern China (Varis and Vakkilainen 2001). It is estimated that the average water yield reduction due to afforestation may vary from about 50 mm/year (50%) in the semi-arid Loess Plateau region in northern China to about 300 mm/year (30%) in the tropical southern region (Sun et al. 2006). Therefore, the tradeoff between forest carbon sequestration and watershed water provision should be carefully and scientifically considered during the implementation of the afforestation plan.
- (b) Afforestation activities have been highlighted in the action plan. However, due to the current large area of artificial forest area in China, the focus should also be on the improved management of existing forests. The current forest area is about 174.9 million ha, of which 34.1% is artificial forest less than 30 years old (State Forestry Administration (SFA) 2005). Through good management practices, these existing forests have the potential to sequester more carbon (Watson et al. 2000; Canadell and Raupach 2008). Thus, it is equally important to improve existing forest quality as it is to enlarge the area of afforestation.
- (c) Soil is a key part of forest ecosystems, and plays an important role in forest ecosystem carbon budgets. Existing forest management aimed at soil improvement

Table 1 Key fields and associated forestry activities addressing the issues of climate change

Goal	Field	Activity
Mitigating climate change	Afforestation	Advocating national-wide voluntary tree-planting
		Implementing key afforestation projects to enlarge forest area
		Hastening silviculture of precious timber forest
	Forestry biomass energy	Implementing projects integrating silviculture with utilization of biomass forest
	Forest sustainable management	Implementing forest management projects
		Enlarging enclosures for forest restoration and improving pure artificial forest
	Forest resources protection	Strengthening forest harvesting management
		Strengthening forestland acquisition management
		Increasing forestry law enforcement capacity
		Increasing forest fire control capacity
Adapting to climate change	Forestry industry	Increasing forest disease and pest control capacity
		Developing and using biomass materials rationally
	Wetland restoration, protection and use	Increasing recycled use of timber
		Increasing protection and restoration of key wetlands
	Forest ecosystem	Demonstrating sustainable agricultural-pastoral- fishery resource use
		Increasing adaptation of artificial forest ecosystems
		Establishing natural reserves for typical forest species
		Strengthening protection of key species
	Desert ecosystem	Increasing monitoring of wild animal disease and early-warning capacity
		Strengthening vegetation protection in desert areas
	Wetland ecosystem	Strengthening basic works of wetland protection
		Establishing and perfecting wetland natural reserve network

can potentially increase forest soil carbon stocks significantly (Richter et al. 1999; Johnson and Curtis 2001). The improvement of forest soil can not only increase the rate of stand growth, but also sequester more carbon within the soil layer. Therefore, on the basis of forest ecosystem health, management to improve forest soils must be implemented.

In conclusion, China's forestry industry has started to implement the development strategy to mitigate climate change. It is expected that with appropriate forestry management China can contribute to a 40 to 45% reduction in greenhouse gas emission intensity by 2020.

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