Implications of climate policies for cropland and forests under varying time preferences and yield assumptions

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INTRODUCTION

The U.S. forest and agricultural sectors can play key roles in greenhouse gas (GHG) emissions abatement as well as contributing to national goals for renewable energy. Over the last two decades, land use, land-use change, and forestry have reduced the aggregate U.S. emissions of 6,801 TG/yr carbon dioxide equivalents (CO2e) by 849 TG/yr, or 12% (EPA 2011). Similarly, the development of biomass as a feedstock for liquid and electric power has jumped and is projected to grow in the future. EIA projects in their 2012 Annual Energy Outlook that biomass will account for 30 percent in a doubling of renewable energy consumption in the electric power sector through 2035.

Forest landowners, farmers and ranchers have a wide variety of production and land management practices that could either lower the emissions of their operations or increase carbon sequestration in soils, biomass, and products. Recent climate change policies considered at the national level and adopted regionally aim to reduce GHG emissions through market mechanisms. Other policies at the national and state levels have set clean energy standards that have promoted the use of biomass for transportation fuels as well as for generating electricity.

OBJECTIVE

Past studies evaluating afforestation response to climate policy have utilized either econometric models (Lubowski et.al., 2006), or net social surplus maximization in a partial equilibrium framework either at the annual time scale (Lewandrowski et. al. 2004) or through intertemporal optimization of all time periods simultaneously (Alig et. al. 2010). Investments in forest and agriculture are inherently different due to the time scales and risks involved. Future returns from these investments must be discounted to the present and compared with future returns from other potential activities. This dependence on the future returns makes the discount rate an important consideration in the afforestation decision.

METHODS

This paper utilizes an inter-temporal partial equilibrium model to simulate markets for agriculture, forestry, and bioenergy to evaluate the impacts of discount rates and afforestation growth rates on potential mitigation in the sectors. The model structure provides an endogenous representation of the long term land use change decisions between sectors. We evaluate discount rates of 3% and 7% based on the recent range from the Office of Management of Budget (OMB Circular 94).

We also vary afforestation yields by region and forest type based on USDA Forest Inventory and Analysis (FIA) measured forest plot data on lands recently converted from agricultural to forest use. Our scenarios include the mean along with the upper and lower 95th percentile of the mean yields representing higher and lower management intensity respectively. Each of the discount rate and yield values were evaluated over a range of carbon prices

RESULTS

Table 1. Additional afforested acres through 2040 for each discount rate, afforestation yield level, and CO_2 price

Discount Rate	Afforestation Yields	$/t CO_2e 5	15	30	45
3 Percent		*thousand acres*			
	Lower 95th	7,315	16,463	30,261	45,717
	Average	1,863	2,779	18,427	46,475
	Upper 95th	1,591	1,821	4,194	20,071
7 Percent		*thousand acres*			
	Lower 95th	368	3,574	22,763	31,019
	Average	219	494	2,293	2,159
	Upper 95th	703	2,011	3,763	5,313

Table 2. Additional average annual emissions through 2040 for each discount rate, afforestation yield level, and CO_2 price

Discount Rate	Afforestation Yields	Carbon Price $/t CO_2e 5	15	30	45
3 Percent		*annual t CO_2e*			
	Lower 95th	(18)	(51)	(102)	(134)
	Average	(12)	(31)	(112)	(218)
	Upper 95th	(15)	(26)	(40)	(88)
7 Percent		*annual t CO_2e*			
	Lower 95th	(8)	(16)	(97)	(144)
	Average	(8)	(12)	(33)	(62)
	Upper 95th	(7)	(13)	(92)	(144)

Table 3. Average commodity prices (2010 – 2040) for each discount rate, afforestation yield level, and CO_2 price

Table 3a) Corn

Discount Rate	Afforestation Yields	Carbon Price $/t CO_2e 0	5	15	30	45
3 Percent		*$/bushel*				
	Lower 95th	3.27	3.31	3.38	3.45	3.53
	Average	3.32	3.33	3.38	3.45	3.55
	Upper 95th	3.34	3.33	3.34	3.40	3.52
7 Percent		*$/bushel*				
	Lower 95th	3.26	3.25	3.29	3.46	3.56
	Average	3.25	3.29	3.34	3.42	3.54
	Upper 95th	3.26	3.27	3.33	3.42	3.49

Table 3b) Softwood Lumber

Discount Rate	Afforestation Yields	Carbon Price $/t CO_2e 0	5	15	30	45
3 Percent		*$/mbf lumber talley*				
	Lower 95th	342	343	338	338	339
	Average	363	356	355	353	355
	Upper 95th	341	336	332	342	331
7 Percent		*$/mbf lumber talley*				
	Lower 95th	422	416	417	425	399
	Average	396	395	391	393	389
	Upper 95th	386	387	387	385	389

CONCLUSION

In contrast to most prior analyses that utilized single discount rates and yield potentials, our results provide key insights into not just land use change and emission reductions, but also commodity prices and trade. We expect that afforestation incentives and farmer responses will vary according to several policy parameters as well as the discount rate assumed for the private sector. Differences in carbon yield estimates for various tree plantation categories will be considered for regions and management intensity, which can inform future program designs for afforestation efforts. Similarly, the attractiveness of certain carbon incentives will result in different carbon production strategies.

REFERENCES

Alig, R.J., Latta, G, Adams, D.M., McCarl, B.A., 2010. Mitigating greenhouse gases: The importance of land base interactions between forests, agriculture, and residential development in the face of changes in bioenergy and carbon prices. Forest Policy and Economics. 12 (1), 67-75.

EPA. 2011. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2009. Washington, DC: US Environmental Protection Agency. Available at: http://www.epa.gov/climatechange/ downloads/ghgemissions /US-GHG-Inventory-2011-Complete_Report.pdf (last accessed 14 January 2013).

Lewandrowski, J., M. Peters, C. Jones, R. House, M. Sperow, M. Eve, and K. Paustian. 2004. Economics of Sequestering Carbon in the Agricultural Sector. USDA ERS Technical Bulletin no 1909.

Lubowski, R.N., A.J. Plantinga, and R.N. Stavins. 2006. “Land-use change and carbon sinks: Econometric estimation of the carbon sequestration supply function”. Journal of Environmental Economics Management. Vol. 51(2006): pp. 135-152

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