Land Use and Climate Change: A Global Perspective on Mitigation Options: Discussion

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Land use change can play a very significant role in climate change mitigation and adaptation, as part of efficient portfolios of many land-related activities. Questions involving forestry's and agriculture's potential contributions to climate change mitigation are framed within a national context of increased demands for cropland, forage, and wood products to help feed and house an additional 3 billion people globally by 2050, increased land demand for bioenergy production, and millions of hectares of land needed to house another 125 million U.S. residents by midcentury. Three quite different papers, although all share use of Global Trade Analysis Project modeling or data, usefully examine land use and climate change with a global perspective on mitigation options. I summarize highlights and examples of commonalities and differences, with a view toward promoting better dovetailing of research across disciplines and sectors to aid in solving a global issue.

Choi et al. (2011) analyze sensitivity of forest carbon emissions to projected changes in total factor productivity for crops and livestock production, with a new global, dynamic optimization model of the agriculture and forestry sectors. Their base case or reference projection indicates that around 4 million hectares annually will be deforested to agriculture in tropical regions over the next six decades, with a 0.5 billion ton loss of carbon annually. With a scenario of zero technical change in the crop sector, more tropical deforestation results, along with conversion of inaccessible forestland to accessible land uses. Limiting technical change in the livestock sector, however, results in more land devoted to crops and forestry. They point out important regional differences, in that the U.S. livestock area would increase while China sees a larger reduction in livestock area. In contrast to the other two papers, Choi et al.'s work recognizes the importance of modeling the forest sector, including forest growth and harvest dynamics, given the substantial mitigation opportunities residing in the forest sector.

Beckman et al. (2011) report a general equilibrium analysis of biofuel mandates and greenhouse gas (GHG) emissions. Using numerical simulation experiments and reflecting heterogeneous land productivity, they find that biofuel mandates cause a country's livestock and forestry sectors to shrink, albeit in the absence of carbon prices. Pasture and forestlands are converted to croplands to meet mandates, but this fails to consider use of cellulosic biofuels, given that experimental wood-based plants are in place and are likely to contribute within the study's 30-year time frame. Their GHG accounting does not include that from agricultural (e.g., use of fertilizer) production, and also does not include non-CO_2 GHG emissions. They do not model the simultaneous impact of bioenergy and GHG policies (e.g., carbon sequestration in forests) (Alig et al. 2009). As with Gurgel et al. (2011), the bioelectricity part of bioenergy, such as the large amount of available manure feedstocks, is not included; nor does either study explicitly consider agricultural lands expected to be lost to developed uses. The two papers are slanted toward agriculture, missing investigation of substantial mitigation opportunities in the forest sector. Reliance on a zero discount rate and 30-year time horizon by Beckman et al. (2011) contrasts to other papers in this session including Gurgel et al. (2011), setting the discount rate equal to growth in carbon prices. A static equilibrium approach and use of a 30-year time horizon precludes the many important forest rotations that exceed 30 years, without any

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periodic detail on activities within the 30-year interval.

Gurgel et al. (2011) model effects of alternative carbon price policies and alternative assumptions about the elasticity of substitution for agricultural inputs. Effects reported are GHG emissions, land use, biofuel production, and food prices, using a global computable general equilibrium model: Emissions Prediction and Policy Analysis. The authors begin with a distinction between ecosystem services with use and with non-use values, although this may not be clear for supporting and provisioning services, such as nutrient cycling and soil creation, where the value goes beyond non-use or existence values, as they provide the foundation for economic activity. Gurgel et al.'s inclusion of ecosystems services in their paper's title is not commensurate with the quite limited treatment in the paper. The stated interest of the paper is "how demand for these various ecosystem services may be complementary or competitive and how pricing of all new services may affect land use, food prices, and the prospects for biofuels production." However, tradeoffs between alternative services are not discussed, and any complementarity among policies, land uses, and service provision is unclear.

The concept of household production of recreation services using leisure, land, and other goods as inputs may be worth exploring; however, recreation does not receive much treatment later in the paper. The paper has a GHG accounting approach based on the net present value of carbon flux resulting from land use transition, without clear reporting about other interrelated GHG dynamics. Is the parameter for how long to reach a carbon equilibrium following land use transition based on empirical evidence by land use? Their estimate of land-based sequestration offsetting up to one-third of fossil fuel emissions is about double that of estimates of current levels.

Overall, the three papers reflect aspects of rapid growth in the literature, with a wide range of assumptions or approaches in analysis of climate change mitigation. Although not totally unexpected as the literature expands, however, planning beforehand to coordinate use of common data and assumptions in modeling exercises for this session could have been useful, including taking better advantage of the Global Trade Analysis Project thread. Further significant advances could be promoted by tapping more into knowledge across sectors and taking a broader view of biophysical/ecological and economic aspects.

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