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Agricultural landowners' response to incentives for afforestation

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ABSTRACT

Previous research has shown that afforestation of agricultural land is a relatively low-cost option compared to energy-based approaches for mitigating net carbon dioxide emissions, and that financial incentives affect landowner behavior and can be used to increase carbon sequestration on private land. In this paper we use stated preference data from private landowners in the Pacific Northwest region of the U.S. to examine the key factors affecting participation in an incentive program for carbon sequestration through afforestation. We also estimate the corresponding potential for carbon sequestration and its cost. Our results suggest that incentive payments would significantly and positively affect landowners' level of enrollment in a tree planting program.

1. Introduction

Climate change due to the accumulation of greenhouse gases (GHG) in the atmosphere is one of the major issues in the global economy (Stern, 2007). The forest sector can play an important role

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in mitigating GHG emissions by sequestering carbon from the atmosphere in standing live trees as well as in other forest ecosystem components such as the understory and soil (Alig, 2010). Forests offset approximately 13% of U.S. GHG emissions in 2008 (USDA, 2011). Because forests have relatively larger potential for carbon sequestration than other land use choices (Gorte, 2009), afforestation, or planting trees on land not previously in forestry, is often promoted as a strategy for increasing carbon sequestration (Moulton and Richards, 1990; Adams et al., 1999). For instance, it has been established that afforestation of cropland can sequester between 2.2 and 9.5 metric tons of carbon-dioxide equivalent per acre per year (Mt CO_2 equiv./acre/year) (US EPA, 2005), and afforestation of pasture land can sequester between 2.7 and 7.7 Mt CO_2 equiv./acre/year (Lewandrowski et al., 2004).[2]

Much of the economics literature that examines afforestation of agricultural land has focused on estimating the costs of carbon sequestration, and has shown that afforestation is a relatively low-cost option for mitigating CO_2 emissions. For instance, Parks and Hardie (1995) use Natural Resource Inventory data and an engineering cost model to simulate the impacts of subsidies for sequestering carbon in new forests established on agricultural land. They derive a carbon supply function to develop criteria for enrolling lands in a national carbon sequestration program. Sectoral optimization model approaches, such as the U.S. agricultural sector model (USMP, Lewandrowski et al., 2004) and the forest and agricultural sector optimization model (FASOM, Adams et al., 1993; Alig et al., 1997), have explicitly modeled the links between agricultural land, forest land, and timber markets, and examined the potential for offsetting changes in land use resulting from price feedbacks.[3] These studies rely on financial incentives, mostly tax/subsidy combinations, to measure the costs of afforestation programs. They strongly suggest that financial incentives and changes in relative returns to land use affect landowner behavior and can be used to increase carbon sequestration in private forests.

Plantinga et al. (1999) argue that these studies tend to underestimate the marginal costs of carbon sequestration by simply assuming that landowners will participate in an afforestation program if the specified agricultural returns are compensated, which ignores various factors affecting landowners' decisions. As an alternative approach to increase the accuracy of estimating marginal costs of carbon sequestration through afforestation, Plantinga (1997), Plantinga et al. (1999), Stavins (1999), and Lubowski et al. (2006) estimate econometric models of observed land use decisions as a function of relative returns to different land uses and other relevant factors such as land quality. The estimates from these land use models are used to simulate how landowners might respond to the effects of hypothetical economic incentives such as a subsidy for carbon sequestration. These responses are then used to calculate the opportunity costs of afforestation and hence carbon sequestration cost functions. By relying on observed land use choices, this approach accounts for additional factors affecting land enrollment decisions, such as irreversibilities and the resulting option values, the cost of acquiring forest management skills, and non-market benefits derived by landowners (Plantinga et al., 1999).

Although these econometric models estimated from revealed preference data account for additional factors affecting land enrollment decisions, they mostly cannot incorporate information about individual landowners' characteristics and land characteristics. An alternative approach, which has been used less frequently, is to examine the carbon sequestration potential of afforestation, as well as its cost, using stated preferences. For instance, Van Kooten et al. (2002) and Shaikh et al. (2007) use survey data to examine the effects of incentives to encourage landowners to plant trees on agricultural lands in Western Canada. This approach allows researchers to incorporate key factors affecting individual landowners' land use decisions and to improve the accuracy of examining the cost of carbon through afforestation, and thus can serve as a valuable complement to revealed preference studies,

[2] The ranges in sequestration reflect variation in tree growth rates as well as in above- and underground carbon sequestration rates across species and locations (Gorte, 2009).

[3] The USMP is a spatial and market equilibrium model that simulates farm-sector impacts resulting from changes in commodity market conditions, agricultural technologies, and government policies related to commodity production, resource use, environmental quality, and trade. The FASOM is an intertemporal market and spatial equilibrium model in which agriculture and forestry compete for the use of land. It considers endogenous decisions on afforestation, deforestation, and forest management, and tracks changes in the net levels of carbon sequestration occurring over time.